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APPARATUS FOR CONTINUOUS DISTILLATION SYSTEM.

By Von Egrot.

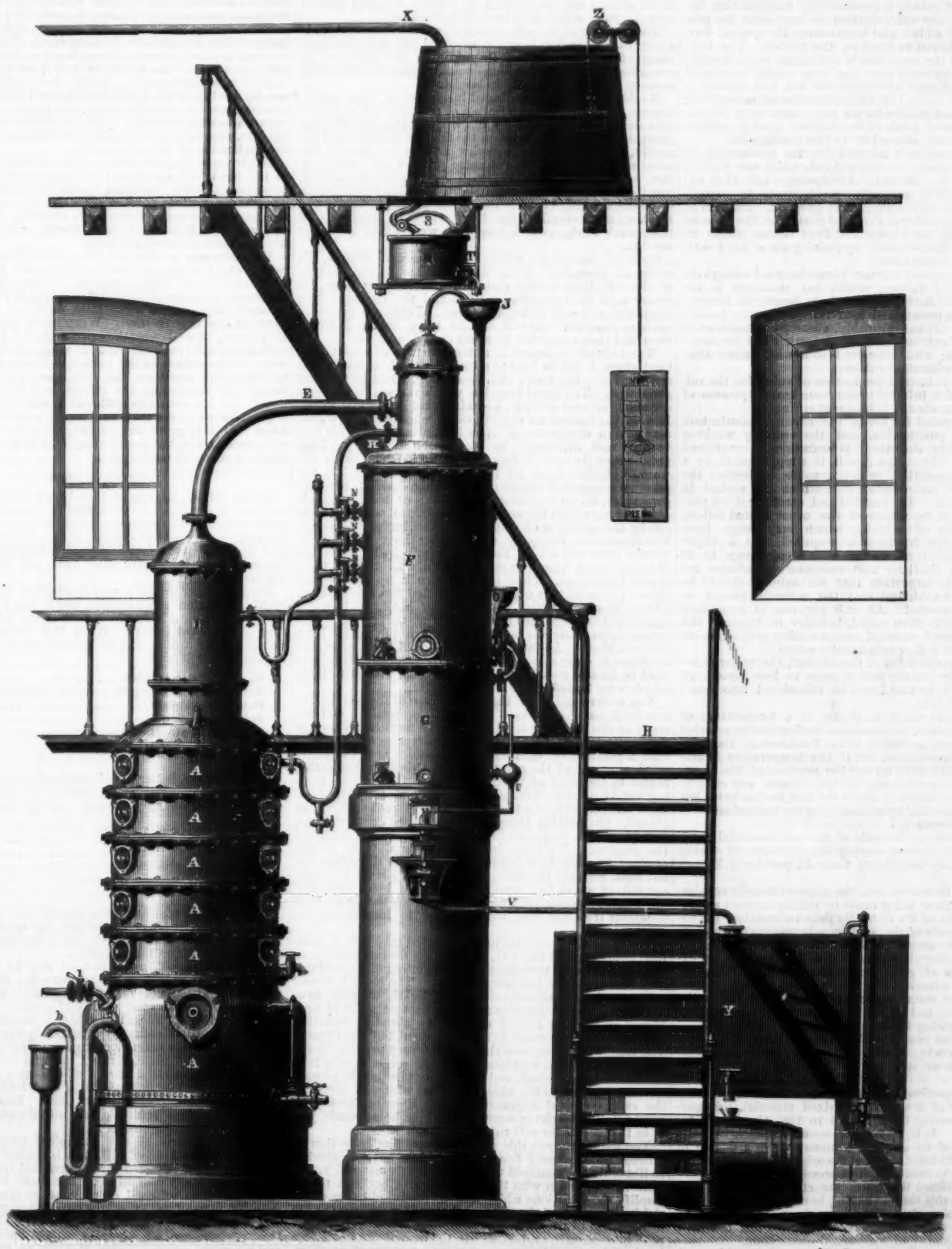
The engraving illustrates a new distilling apparatus invented by Egrot, Paris.

The mash used for the distillation is first put into the mashing tub, Z, and the height to which it is filled is shown by an indicator which is connected by means of a string with the swimmer floating upon the liquid, and can thus be recognized by the laborers in the lower room. From this tub the mash passes through the tap, S, which is also connected with a swimmer, and which regulates the outflow according to the height of the liquid, enters into the regulation vessel, R, from R through the tap, T, into the funnel, J, and from there it flows into the cooling apparatus, G, then to the heating apparatus, F, and through the pipe, K, to the distillation apparatus, A A.

When the apparatus has to be heated with open fire, the boiler, A^1, is filled with water, which is introduced through the opening, *d*. The vapors from the boiling water pass through the distillation chambers, A A A, where the alcohol is separated from the water. The developed alcohol vapors rise to the rectification vessel, D, where they are cleansed from all foreign substances, and finally enter through the pipe, E, to the rectification spiral which is contained in the cylinder, F. From there they go to the cooling tube, which passes in many coils through the cylinder, G, and flow as a liquid through J to the testing apparatus, V, and through the tube, V^1, to the vat, Y.

The mash takes, as already indicated, a way opposite to that of the alcohol, for it ascends through G to F, through the pipe, R, to the distillation chambers, A A, and from there, finally, to the boiler, A^1, from where, separated from the alcohol, it flows off through the tube, *b*.

The mash running through the interior galleries which are contained in the several chambers, A A, comes in contact with a great number of small boiling tubes which separate the alcohol vapors and keep it in continual motion; for



VON EGROT'S IMPROVED DISTILLING APPARATUS.

this reason it easily sets free its alcohol, and only ten or fifteen minutes are necessary for the complete distillation in the apparatus.

The products which this process yields are of a very high quality, because, during this short period of the distillation, obnoxious and badly smelling oils cannot be formed.

[Continued from SUPPLEMENT No. 251, page 3995.]

THE INDIA-RUBBER AND GUTTA PERCHA INDUSTRIES.

By THOMAS HANCOCK, F.C.S.

LECTURE V.

EBONITE OR VULCANITE.

THE fact that rubber becomes hard and hornlike, when the operation of vulcanization is carried on to an extreme degree, was recognized by Hancock, in his earlier experiments concerning vulcanization; but it was not for some years afterward that the industrial importance of hard vulcanized rubber was duly recognized.

Between the years 1840 and 1850, Charles Goodyear produced some fine specimens of ornamental work, in the material in question, and these fully demonstrated the industrial value of vulcanite or ebonite; proving conclusively that the most delicately modeled objects can be faithfully reproduced in hardened India-rubber.

I am indebted to Mr. Sexton for the opportunity of showing to you a unique collection of Goodyear's earlier specimens, these being of a character calculated to surprise some of those who judge of the possible developments of the ebonite industry, by those articles which are now met with in the ordinary channels of trade.

Hard vulcanized rubber is produced by exaggerating the conditions of ordinary vulcanization, or increasing the proportion of sulphur added, and lengthening the period during which it is allowed to react on the rubber. The temperature at which the operation is conducted may, in some cases, be slightly elevated over the heat usually employed in the case of ordinary vulcanization; but this course is more or less liable to lead to the production of unsound or spongy ebonite, and those who are most successful in the regular production of goods of the highest quality seldom employ a temperature above 135° to 140° Centigrade.

The sorts of rubber best adapted for the production of ebonite are those hard and fibrous kinds which are yielded by the islands of the Malayan Archipelago; and that obtained from Borneo is generally considered to be exceedingly well adapted for the purpose in question. Rubbers of the African tongue order are not adapted for the ebonite manufacture, while the high-priced Para rubber yields an article inferior to that obtained by making use of the lower-priced rubbers first mentioned.

Before proceeding any further, please be good enough to notice this strip of rubber, which has remained in the melted rubber bath during the last three hours, the temperature having been maintained near 140° during the greater part of the time. It has, probably, absorbed as much as 40 to 50 per cent. of sulphur, and has altogether lost its extensibility by tension; while its color is somewhat darker than that of ordinary vulcanized rubber.

As regards the industrial production of vulcanite, the sulphur bath method is inferior to the more certain process of mechanical admixture and subsequent curing.

The rubber intended for use in the ebonite manufacture requires careful purification, and the ordinary washing process, as already described, is occasionally considered to be insufficient. In such a case it is supplemented by a kind of deviling operation, which consists in tearing the rubber into shreds under water, after which it is soaked in an alkaline solution. The purified and carefully dried rubber is next mixed, by means of the usual heated rollers, with a proportion of sulphur, which may range from 50 per cent., when hardness is required, and a slight degree of brittleness is not considered a disadvantage to 25 per cent., when elasticity and comparative softness are wished for. It is important that the sulphur should be dry and free from acid, and that the materials should be thoroughly incorporated. About 3 per cent of lampblack or vegetable black is often added, in order to improve the color of the finished material, and a similar proportion of calcined magnesia is also occasionally added.

During the incorporation of the sulphur, the material becomes remarkably plastic, and appears to lose almost all traces of elasticity, so that it can be calendered into sheets with very great facility.

Ebonite is usually cured in steam, at a temperature of about 135° Centigrade, the operation lasting during a period of 6, 8, or 10 hours, according to the thickness of the articles or other circumstances, but if the temperature is gradually raised to 140–150°, during the progress of the operation, a much shorter time may suffice. Under any circumstances, it is unadvisable to apply the full heat at once, but first to set the material, by commencing the vulcanization at a moderate temperature.

The articles built up or made of the soft material generally require more support during the operation of curing than is afforded by embedding them in powdered French chalk.

In the case of ebonite sheets, the support usually consists of plates of tin, these being made by rolling together a number of thicknesses of tin foil. By thus vulcanizing the ebonite between sheets of tin, a surface is produced which is so smooth as to be almost polished, while a similar end may be attained by using glass plates for a like purpose, an extremely thin film of grease, or preferably wax, being applied to prevent adhesion.

Several distinct stages or steps may be traced during the curing of ebonite; and I wish to call your attention to some specimens illustrating these various stages.

Here, in the first place, is the plain mixture of sulphur and rubber, this being nearly white, and capable of becoming quite plastic or soft by the application of a gentle heat.

The second specimen illustrates the action of a very moderate degree of heat on the mixed material, this particular sample having been heated to 128° Centigrade for twenty minutes. It is, as you see, somewhat darkened, and has lost a little of its original softness; while a degree of heat which would have rendered the original mixture plastic, like putty, fails to make much impression upon it.

The third specimen illustrates the effect of a more prolonged heating, this sample having been heated for an hour to 135° Centigrade. It is olive green in color, and has acquired a certain amount of elasticity, resembling that of a rather inferior quality of vulcanized caoutchouc.

The fourth stage of curing is illustrated by this specimen, which you see is brown, and tolerably hard. Ebonite in this state refuses altogether to become plastic by heat, and a temperature of 150° maintained for half an hour or less would suffice to bring it to the fifth stage, or that of finished ebonite.

The fifth stage, or that of properly cured ebonite, is the goal to be arrived at in manufacturing the material. There should be no places where the curing is imperfect, a kind of defect which is likely to happen when articles of unusual thickness are vulcanized, and no portion of the ebonite should be spongy or honeycombed by air bubbles.

The sixth, or spongy state, is generally the result of overheating, bubbles of gas forming in the material, and converting it into a kind of porous cinder-like mass.

A specimen will now be handed round, which illustrates the third, fourth, fifth, and sixth stages, as already described. The specimen in question was cured on a hot plate, this having probably been heated to 160° or 170° Centigrade; and you will be able to trace all gradations in the curing operation, from the first setting of the plastic material to the destruction of the ebonite by overheating.

A study of the sample in question points very clearly to the propriety of curing ebonite at a low temperature, especially when articles of considerable thickness are operated upon; as the long continued moderate heat tends to insure equal action through a considerable mass. Very small or thin articles may be cured rapidly without much chance of mischief arising. It very often happens that when thick articles are required to be made of ebonite, it is found convenient to build them up layer by layer, and cure each before adding another. New material adheres very perfectly to old, and unites thoroughly during vulcanization, provided that the old has not been so far cured as to become extremely brittle, and that it is well roughed up before the fresh material is applied. A little of the mixed but uncured ebonite may be softened by benzole and well rubbed over the place where additions are to be made.

The working of the soft, mixed ebonite, before curing, is a very easy matter, as it can be moulded into any form, and pieces of it may be united by warming the edges, or by smearing them with a solution or paste, made by dissolving some of the mixed material in benzole.

Moulds of tin, of brass (tinned inside), or of type metal, answer very well; the application of a trace of oil, followed by a thorough brushing with black lead, being an effectual preventive of adhesion between the finished material and the mould. In building up complex articles of ebonite, the usual method is partly to vulcanize or cure the main portion, bringing it, say, to the fourth stage, already mentioned, and then to make the required additions. Many articles can be advantageously cured in moulds of plaster of Paris; and I believe that several of the finely modeled specimens of Goodyear's work, now before you, were made in plaster moulds.

Casts of phototypic reliefs can be made of ebonite, the mode of procedure being quite similar to the making of the soft India-rubber casts. One or two of these, together with the type-metal moulds and the corresponding negatives, will now be handed round. Tubes are generally made on mandrels, the soft ebonite being wrapped round these and then supported by a wet cloth bound over.

When ebonite is heated to a temperature of about 100° Centigrade, it can be bent to a certain extent, as the heated strip serves to illustrate; and, on cooling, it retains the form given to it. The spiral bracelets which you see on the table are manufactured straight, and afterward bent while warm. In a similar manner an ebonite disk, when slightly warm, may have a device struck upon it coin fashion. This can be very well illustrated by means of the small striking press which is now before you. Notice how ready the warmed ebonite takes an impression of the die, but the pressure required is considerable, and the device is not very permanent, as, on warming such a coin, or medal, the ebonite recovers from the state of tension into which it was put by the operation of coining and the image disappears. The Silvertown Company manufacture large numbers of ebonite coins and tokens, these being principally made use of in the South American States, and a collection of these is now before you. These coins are struck up by repeated blows, produced by a press so constructed that one spoke of a loose flywheel, which is worked by hand, shall strike against a driver attached to the screw of the press. This arrangement renders it easy to force down the screw by a series of blows. Let me now heat a few of these coins over the flame of a gas stove, after which the resulting plain disks shall be handed round, together with coins similar to those which were heated.

You understand, then, that in the case of these coins, the low level parts exist in a state of compression, and are ready to rise up to the level of the other portions as soon as the application of heat enables the molecules of ebonite to take a position of equilibrium. Consider now the effect of planing one of the coins, so as to reduce the projecting points to the level of the compressed parts, and then heating the blank thus obtained. You shall see for yourselves. Here are some coins which have been so rubbed down, or planed. On heating them the compressed parts rise up, and the device reappears in *intaglio*, with all the details of the original. We have, in fact, a reproduction of the original die, only it is reversed as regards direction—the left hand becomes the right, and *vice versa*. Here is a coin, one side of which has been rubbed down level, while the other side is untouched, and on heating this the device will disappear from one side and reappear in intaglio on the other side.

The property of ebonite just illustrated may have a practical application in this way. It is often desirable to obtain quickly a reversed reproduction of a printing block, and this may be done in the following manner: The block is forced against a sheet of ebonite, this being slightly warmed, so as to obtain a sunk impression; and the ebonite plate is next planed off level, or rubbed down by an abrading material, after which it is exposed to a heat of about 140° Centigrade. The compressed lines now rise up and form a printing block, which is an exact reproduction of the original, only it is left-handed or reversed, and to fit it for printing it is only necessary to deepen the widely extended whites by means of the ordinary wood engraver's tools. Ebonite forms very good printing blocks or stereotypes, these being made just as in the case of the soft rubber stamps.

You see before you this evening a very fine collection of articles manufactured from ebonite, these not only serving to illustrate the manifold uses to which this material is applied in connection with the industrial arts, but also to exemplify the variations which may be produced in the material itself, as regards hardness and elasticity, by varying the composition of the original mixture in accordance with the principles already explained. In the case of specimens lent by the Silvertown Company, you see a number of small articles of exquisite finish, and you will not fail to notice the collapsible drinking cup for travelers. Messrs. Cow & Co. have lent me two extremely fine specimens of vulcanite work, one being a what-not, consisting of thick slabs of ebonite, supported by turned columns of the same material, and the other being an inlaid slab, built up of a kind of mosaic, formed out of variously colored pieces of vulcanite, and you will notice that some of the pieces are nearly white. The conditions under which nearly white and colored vulcanite can be obtained will be described further on. Mr. Falkenstein, of the Britannia Rubber and Kamptulicon Company, has brought me some admirable specimens. You will notice the thin ebonite sheet, almost like paper, which this firm manufactures, and also the extensive selection of fancy and ornamental articles, these being, for the most part, made after Mr. Falkenstein's own designs. Here is a reproduction of a medal which has been moulded in vulcanite by Macintosh & Co., of Manchester.

Ebonite works very much like horn or ivory, and can be very readily turned at the lathe, but a high rate of speed is required. A finish can be given to the articles by the use of flour-glass paper, followed by the 000 emery paper used by watchmakers, after which a final polish can be rapidly given by the arrangement to be described. A number of rough pieces or disks of cloth are clamped, circular-saw fashion, on a spindle, and this is made to revolve at a very high rate of speed—say about 4,000 revolutions per minute. This polisher being slightly charged with fine brick-dust and water, oil, or paraffin, the articles to be polished are held against it, when they soon receive a high degree of polish. Rottenstone may also be used on a polisher of this kind; and one considerable advantage attending the use of the polishing apparatus in question is the ease with which variously shaped articles may be operated upon.

Small flat articles may be very readily polished by rubbing them on blotting paper charged with tripoli or rottenstone. Many metals, especially iron, may be embedded in soft ebonite and fixed very firmly by vulcanization; and advantage is taken of this circumstance in many cases. Thus the handles of steam and hot water cocks may be advantageously clothed with ebonite, and iron screws may be fixed into ebonite insulators in a like manner. Again, India-rubber rollers are usually fixed on to their iron spindles by means of a layer of ebonite placed next to the metal, the ebonite and the soft rubber adhering perfectly, while the ebonite adheres well to the iron, especially if the metal is somewhat toothed before the application of the soft material.

To give anything like a list of the applications of ebonite to the industrial arts would be impracticable, but its more important uses are illustrated by the specimens before you. The characteristic properties on which its usefulness principally depends are its hardness, elasticity, electrical non-conductivity, freedom from porosity, and its inertness towards most chemical products.

Vulcanite may be obtained in a colored form, by incorporating with it a large proportion of certain pigments, such as ultramarine, vermilion, sulphide of cadmium, sulphide of antimony, or oxide of chromium; while, if it is required in as nearly as possible a white state, oxide of zinc and sulphide of zinc may be used. When these pigments are incorporated, there is not the same necessity for pushing the vulcanization to such extremes as when rubber and sulphur alone are employed, as the pigments themselves give a certain degree of hardness. In such cases the proportion of sulphur, in relation to the rubber, may be very much reduced, and it is generally sufficient to carry on the curing to a point between the third and fourth stages, as already defined. At this point the rubber has a brownish or dark olive green color, but the presence of a large proportion of pigment serves to mask this.

DENTAL RUBBER.

Dental rubber, the material used for setting or mounting artificial teeth, consists of a highly pigmented vulcanite, made to imitate the natural color of the gums. There are on the table some very fine samples of the material in question, and for a portion of them I am indebted to Mr. Sangster, the representative of the New York and Hamburg India-rubber Company.

Dental rubber forms a very convenient material for the making of various small articles, and it may be readily cured in the small vulcanizers which were shown you on the occasion of the third lecture. When it is desired to have a dental rubber, which can be rapidly cured, the following composition will serve:

Washed Borneo rubber	25
Vermilion containing 33 per cent of free sulphur,	30
Powdered sulphur	5
Sulphide of zinc	20
Sulphate of strontium	20
	100

It is, however, better, if color and quickness of curing are not very primary objects, to approximate more nearly to the composition of ordinary ebonite. As for example:

Rubber	45
Vermilion, as above	20
Sulphur	15
Sulphate of strontium	20
	100

A small portion of fine gutta percha may be incorporated with the material for dental rubber, the result being advantageous in many cases; and shellac is occasionally added to the materials for ordinary ebonite.

The turnings and dust of ebonite may be compressed in hot moulds, so as to form buttons or other small articles, or these residual products may be mixed with new rubber and sulphur to form a second quality of ebonite.

When ordinary vulcanized rubber is heated to 230° Centigrade, or until it melts, a permanently viscous product is obtained, and this substance, if mixed with emery and sulphur to a kind of paste, forms a material out of which the so-called agglomerated emery wheels or grinders may be formed, the mixed materials being next hardened or cured by the application of a steam heat. Emery wheels and hones made on this principle were introduced by Deplanque, about twenty-three years ago.

Thirty-five parts of old vulcanized caoutchouc having been placed in a kind of still, heat is applied to melt it, the operation being assisted by the gradual addition of about ten parts of heavy coal oil; but this latter is afterward distilled off. The softened caoutchouc is then incorporated with 500 parts of emery of the required degree of fineness and nine parts of sulphur. These materials having been thoroughly mixed, the hones or wheels are manufactured, and afterward cured or baked at a heat of 140° Centigrade, during a period of about eight hours. Grinding wheels,

made in the above manner, can be worked at a speed of 2,000 revolutions per minute, and are extremely useful for the working of hardened steel or other obdurate materials. Some of the wheels, and also some knife sharpeners, are now on the table before you.

The substitutes for India-rubber are of comparably little importance in relation to caoutchouc itself. Oxidized linseed oil is occasionally used in the making of flexible tubes for leading gas or for surgical purposes; indeed, I should rather say, for waterproofing such articles after they have been built up of fibrous materials. Such tubes, of which several specimens are before you, are far inferior to rubber tubes in most cases, and are formed by repeatedly varnishing the fibrous base with a carefully prepared linseed oil varnish.

VULCANIZED OIL.

Vulcanized oil is, perhaps, of more interest, and many oils, such as linseed and others resembling it, may be vulcanized by being heated for some time to 150° Centigrade with 12 to 20 per cent of sulphur. The product obtained is soft, and somewhat resembles very bad India-rubber. By increasing the proportion of sulphur very much indeed, say to four times the weight of the oil, and vulcanizing at a higher temperature, a hard substance, resembling inferior vulcanite, is obtained.

Soft and hard vulcanized oil have been introduced into commerce at various times and under many names; but these materials never seem to have made very much headway.

SUBSTITUTES FOR RUBBER—CELLULOID.

Various products, having pyroxyline or soluble gun-cotton as their basis, have been introduced as substitutes for hardened caoutchouc. Parkesine, a substance made by incorporating pyroxyline and linseed oil, forms a material well fitted for the manufacture of knife handles or similar articles; and I will now hand round a very beautiful specimen, which is well worthy of your notice.

The substance now known as celluloid, which consists essentially of pyroxyline and camphor, appears, however, to have characteristic properties which will enable it to fulfill certain purposes for which vulcanite is ill-adapted.

A solution, containing about equal parts of camphor and tetrachloride of carbon, dissolves or softens pyroxyline very readily, and if such a solution is incorporated with a sufficient proportion of the soluble nitro-cellulose, a dough-like mass is obtained, which hardens on the evaporation of the tetrachloride of carbon; but the material may be again made plastic and workable by being heated to a temperature between 100° and 125° Centigrade.

Many other methods of incorporating camphor with pyroxyline or nitrocellulose may be adopted; as, for example, the mere mechanical admixture of the materials at a carefully regulated temperature. Again, the camphor may be dissolved in carbon disulphide, liquefied sulphurous acid, or other solvents. Celluloid may be and often is mixed with resinous substances or coloring matters.

Another celluloid-like body, due to the ingenuity of Mr. Parkes, of Birmingham, is obtained by softening nitro-cellulose by means of alcohol, and forcing the product into moulds. This substance is exceedingly tough, while it has the advantage of being free from camphor, and is capable of resisting the action of heat to a considerable extent.

Celluloid and analogous products have the disadvantage of being very inflammable, and instances have been known of these bodies igniting by percussion.

Buttons, combs, billiard balls, and other similar articles are made of celluloid, the soft material being usually forced in iron or steel moulds. Most wonderfully perfect stereotypes may also be made of the material in question. Celluloid is also coming much into use for making artificial gums or bases for teeth.

LECTURE VI.

GUTTA PERCHA.

Gutta percha is quite secondary to India-rubber as regards the number of its industrial uses, but there are cases in which it could be but ill replaced by India-rubber. It differs from rubber principally in being more readily softened by heat, in being far less porous, and in lacking that ready extensibility by tension which is especially characteristic of caoutchouc.

The *Isonandra gutta*, a fine tree which often grows to a height of over eighty feet and whose stem attains a diameter of three feet or more, is the principal source of the milky juice or sap which, when indurated, forms the crude gutta percha of commerce. The *Isonandra gutta* flourishes notably in Singapore, the eastern part of Sumatra, Borneo, and Java. The lantern slide now projected on the screen will serve to illustrate to you the appearance of the foliage, flower, and fruit of the tree in question; and next, I will show you a slide which represents the operation of collecting the juice or sap.

The *Isonandra acuminata*, also an East Indian tree, yields some gutta percha; while the *Sapota mülleri*, or South American bully tree, has, of late years, afforded a considerable supply of an excellent quality of gutta percha, which passes under the name of "balata."

Gutta percha appears to have been first introduced into this country by Jose D'Almeida, who, in April, 1843, presented some of the raw material, and also a riding whip made of it, to the Royal Asiatic Society. Some months afterward, Dr. Montgomerie presented some of the material to this Society, and a portion of it having been given to Charles Hancock, this gentleman immediately took steps to prove its applicability to various industrial purposes, and the foundation of the gutta percha industry may be said to be due to him.

The operation of collecting the sap of the gutta percha trees is not very different from the corresponding operation with the juice of the rubber trees. But as the gutta percha juice sets readily, no smoking is required; it being sufficient to roll the concreting sap into rough balls or cylinders.

On the table you will find a very interesting collection of samples of raw gutta, some of which are roughly modeled into representations of animals, while others are of interest inclosing stones, lumps of wood, and other adulterating materials. For the greater part of them I am indebted to the Gutta Percha Company of London.

The essential ingredient of gutta percha is white, and appears to be identical, as regards ultimate composition, with caoutchouc. Faraday gives the following figures as the result of analyses of these bodies:

	Gutta percha.	India-rubber.
Carbon	87·2	87·5
Hydrogen	12·8	12·5
	100·0	100·0

The purification of gutta percha can be readily effected by dissolving the crude material in carbon disulphide, and, after some filtration, evaporating the solution. Here is some carbon disulphide, and you see how readily these parings of raw gutta dissolve in it. Let us now filter the solution, and pour some on this leveled glass plate. The solvent will soon evaporate and leave a skin or film of gutta percha. Here is such a skin, or sheet of gutta percha, which is now ready to be stripped from another plate, as the solution was poured on this glass about an hour ago. You see that it is nearly white, and when softened by heat, it becomes most perfectly plastic. The method of purifying gutta percha just demonstrated, was proposed by Parkes, as the foundation of an industrial process for refining gutta percha; but mechanical purifying methods have been generally adopted on a large scale.

Purified gutta percha, as now shown, consists of three constituents. The most important is pure gutta, or the plastic principle; and this forms about four-fifths of the whole. Its chemical composition corresponds nearly with the formula $C_{10}H_{16}$, and it is perfectly white. An oxidized principle, called albane, of which a specimen stands before you, is present to a considerable but variable extent. It forms a white crystalline body, which is soluble in hot alcohol, and corresponds in composition to the formula $C_{10}H_{16}O$. Albane is valueless in gutta percha; indeed it is detrimental, being doubtless, like the body which is to be next alluded to, a product of oxidation or decay. The third constituent of the purified gutta is called fluavile, and forms a yellow oxidized resin, which is soluble in cold alcohol, and has a composition which may be said to correspond with the composition $(C_{10}H_{16})2O$. It is often present to the extent of four to five per cent. in gutta percha of good quality; while the amount of albane contained in good commercial gutta often reaches twenty or twenty-five per cent.

Like caoutchouc, gutta percha is attacked by ozone with great energy; and when exposed to the ordinary conditions of the atmosphere, it becomes oxidized and brittle with so much rapidity that old articles made of gutta percha are usually brittle and useless. Most liquids which dissolve caoutchouc also dissolve gutta gercha; but, in the case of the gutta, there can be little doubt that true solutions, rather than starch-like magmas, are formed.

Gutta percha resists the action of alkaline liquids and of dilute acids, but strong and slightly warm sulphuric acid chars it readily, while concentrated nitric acid converts it into a yellow resinous body. Like caoutchouc, gutta percha is an admirable electrical insulator, and also a very useful non-conductor of heat.

When submerged in water, or in any way protected from the action of air and light, gutta percha has little or no tendency to change; while, on the other hand, constant exposure to light, together with alternating conditions of dryness and dampness, is most unfavorable to its well being. The products formed by its oxidation are of a resinous nature, as in the case of caoutchouc; one of the most notable of these being a body resembling Spiller's caoutchouc resin, and containing 27·9 per cent. of oxygen. It occasionally happens that samples of gutta are met with which resist decay in an extraordinary manner. Here, for example, is a sample of thread which Mr. Walter Hancock has had in his possession for over twenty years, and you will note that it is tough and strong like new gutta. Other samples kept under similar conditions fell into dust as soon as they were touched; and Mr. Hancock tells me that he cannot account for the difference between them.

A temperature of 50° Centigrade serves to soften gutta percha to such an extent that it may be easily moulded into any required form, while at 100° Centigrade it becomes adhesive and pasty, and at 130° it may be said to fairly melt. The products of the dry distillation of gutta percha are generally similar to those obtained by the distillation of caoutchouc.

In the next place, let me very briefly call your attention to the methods employed for effecting the purification of gutta percha on an industrial scale, these being, in the main, due to Charles Hancock.

The first operation is to chop up the crude gutta into slices or shavings, by means of knives or cutters attached to the face of a revolving wheel. These knives are now often made with saw-like edges, each tooth being sharpened like a lancet; and it is found that the effect of this modification is to reduce the gutta into small fragments, like raspings. The finely divided gutta is next soaked and boiled in water, in order that particles of earthy matter may sink, while the gutta floats. During this process, many particles of woody matter become so far sodden with water as to disengage themselves from the gutta and to sink, while any soluble impurities naturally become pretty thoroughly removed.

The next process, known as ticking, consists in chopping up the softened gutta, and allowing it to fall into hot water, this operation, together with agitation in hot water, being repeated until the material is rendered free from foreign matter. The ticker consists of a hopper and a pair of fluted rolls, which lead the soft gutta toward a rapid rotating wheel, which latter has a series of blades or cutters attached to its circumference, and these chop off the gutta in flakes, which fall into hot water. On the table are samples of gutta in its various stages of preparation, these having been kindly lent by the Gutta Percha Company. The material having been ticked and washed sufficiently, can be rolled into sheets at once, but it is usual to both masticate and strain the material when the highest degree of uniformity in texture, together with freedom from foreign matters, is desired.

The masticator employed is similar in principle to that used in treating rubber; but its design is lighter, as the work it has to perform is comparatively easy, and Pfleiderer's kneading machines have been found very well suited for the mastication of gutta percha. The arrangement employed for straining the gutta percha consists of an iron cylinder, in the lower portion of which are placed strainers of iron wire netting or gauze. The cylinder having been heated by means of steam, and filled with the soft gutta, a tightly fitting piston is forced into the upper part by means of hydraulic power, and the gutta is naturally forced out through the wire gauze. A second mastication, after the straining, is sometimes considered advisable.

Very many materials, such as lac, pitch, plaster, magnesia, clay, and other earthy substances, are occasionally incorporated with gutta percha, in order either to harden it, cheapen the material, or to adapt it to special uses; and elastic glue, compounded of gutta percha, resin, and pitch, forms a very useful cement in some cases.

Mixtures of India-rubber and gutta percha are useful in many instances, and a vulcanite, having as its base equal proportions of rubber and gutta, possesses some very excellent qualities as a material for making buttons and other small articles.

As a moulding material gutta percha stands pre-eminent. A copper printing plate can be moulded so perfectly in the material, that an electrotype made on the gutta percha mould yields prints indistinguishable from those taken from the original plate. Again, photographic reliefs may be most perfectly moulded in gutta; and dentists largely make use of it for obtaining casts of the interior of the mouth.

When a strip of gutta percha is stretched by a sufficient force to about double its length, it is found to have acquired a fibrous texture, and to be capable of resisting a much greater strain than that which served to extend it. This can, as you see, be very well illustrated by stretching one-half of this strip.

The use of gutta in covering electrical wires and cables is probably its most important application to the requirements of modern civilization, and numerous specimens, lent by the Silvertown Company, Messrs. Rickards, of Derby, and others, illustrate these uses. It will, doubtless, interest you to see some illustration of the method employed in covering wires with gutta percha. Here is a small metal cylinder which is now full of soft gutta percha, and a solid metal plunger or piston fits into the cylinder. In the front there projects a short tube, the internal diameter of which serves to gauge the external size of the coating on the wire; while opposite it a tube of much smaller diameter passes right through the cylinder and mouths, near the inner extremity of the first mentioned tube. A piece of wire being now slowly drawn through the apparatus (in the case of the diagram from right to left), the plunger is forced down by means of a small press; a tube-like coating of gutta is thus, as you see, forced out around the wire. In the industrial production of the beautifully coated wires you see before you, very complex and finely adjusted machinery is made use of, but the general principle is the same as you have seen illustrated.

Photographic baths, dishes, cisterns, and other similar articles can be readily made out of sheet gutta percha; the edges to be united being softened by a gentle heat, but these articles are generally not equal to similar vessels of ebonite. Gutta percha, however, has the advantage of being very easily workable.

Sound conductors, or speaking tubes, made of gutta percha tubing, are singularly effectual, and are largely used in warehouses and other places.

Rolled or calendered sheets of gutta percha are largely employed—the thick sheets being used for soling boots and such-like purposes, while the extremely thin rolled sheet, which rivals paper in tenuity, finds many uses. As a coating for damp walls it is most effectual, while as a waterproof material for certain surgical purposes it is unrivaled; and for covering over joins in telegraph wires it receives extensive application. No doubt most of you have seen telegraph workmen operate with this material in the streets of London—wrapping it round and round the joint, and at the same time softening it by means of a lamp. The large pieces of thin sheet hanging up have been lent by the Gutta Percha Company, and there are also some interesting specimens for which I am indebted to Mr. Walter Hancock. Please notice the difference between the thin sheet made from gutta percha which has been masticated and strained, and that which has not been masticated. The masticated sheet shows no texture, while that which has been strained but not masticated is paler in color, and shows a kind of grain or texture, which causes it to split more readily in a longitudinal than in transverse direction. Some of these samples, lent by Mr. Hancock, are of interest, as being no less than twenty years old, a great age for gutta percha thin sheet.

Gutta percha tubes are manufactured by the squirting process, already referred to several times; and they are of considerable use for making siphons or conducting tubes intended to convey corrosive liquids. Pump buckets of gutta percha are largely made use of in mines, and are generally found to be much more durable and economical than leather buckets; while pumps made entirely of gutta percha are occasionally made use of in chemical factories. Belting of gutta percha answers extremely well in many cases; but it is sufficiently obvious that the use of this kind of belting is only to be recommended in cases where the temperature of the place is not likely to rise very high.

Funnels, bottles for hydrofluoric acid, jugs, boot soles, various surgical appliances, and fancy articles are also made of gutta percha; and there are on the table some really fine works of art executed in this material and lent by the Gutta Percha Company. Articles of gutta percha may be varnished by an oil varnish—that is to say, by means of a resin or resinous gum dissolved in boiled linseed oil, the varnish being diluted with oil of turpentine as required.

Gutta percha does not appear to be so absolutely impervious to water as is sometimes believed, as thin leaves or sheets of it left in water for a long time absorb sufficient to cause them to sink. The specific gravity of gutta, under ordinary circumstances, is about 0·979, but the above-mentioned circumstance tends to prove that the material, if perfectly free from porosity, would possess a higher specific gravity than water.

The vulcanization of gutta percha is in all respects analogous to that of India-rubber, and its primary effect is to lessen the influence of an elevated temperature on the material. As in the case of caoutchouc, vulcanization may be effected by free sulphur, by sulphides in conjunction with free sulphur, or by certain agents which contain no free sulphur, as hyposulphite of lead and chloride of sulphur.

Parkes' cold curing process, in which chloride of sulphur is made use of as a vulcanizing agent, can be applied in many ways to the vulcanization of gutta percha. Here, for example, is a piece of thin sheet, which is being exposed under a bell jar to the fumes of protochloride of sulphur; it is already nearly cured. As regards the dipping process, certain precautions must be observed, as a mixture of carbon disulphide and chloride of sulphur rapidly dissolves gutta percha. Perhaps the following is the best way of proceeding: The articles to be vulcanized are dipped for an instant in a mixture of one part of chloride of sulphur with twenty parts of carbon disulphide, no time being allowed for solution to take place. The dipped article having been allowed to remain for some hours exposed to the air, reacts with the small proportion of chloride of sulphur taken up from the bath, and its surface becomes partially vulcanized and insoluble. A second dip may now be given, but this time the liquid can be allowed to act during a longer period, the surface of the article being less soluble than was the case before. As the vulcanization proceeds, the articles may be allowed to remain longer and longer in the bath, and the result is that the gutta is vulcanized all through. Vulcanized gutta percha is, with few exceptions, hard, and indifferent alike to the action of solvents or of a temperature as high as 100° Centigrade. Another way of curing gutta percha by the method in question will next be illustrated to you.

Here is a solution containing four parts of gutta percha dissolved in twenty parts of carbon disulphide; and here, on the other hand, is a mixture of one part of protochloride of sulphur with eight parts of carbon disulphide. Having now mixed these two solutions, I will pour one-half of the mixed liquid into a stopped bottle, and the other half on a leveled glass plate. In about ten minutes the liquid in the bottle will have set to a jelly, owing to the fact of the gutta having become vulcanized and insoluble, while that poured on the leveled glass will form a film or skin of completely vulcanized gutta percha, which almost resembles ivory in appearance. Some specimens vulcanized in this manner are now on the table.

When gutta percha is cured or vulcanized by the admixture of sulphur and subsequent heating, the most serious source of failure met with is porosity of the material, this being probably due to two causes. In the first place, traces of moisture may be present; and, in the second, there appears to be some vapor evolved during the earlier stages of the curing.

Traces of water, or of mischief-working essential oil, may be often driven off by heating the gutta to 150° for some time before incorporating the sulphur; or the volatile products formed during the earlier stages of vulcanization may be got rid of by heating the gutta to 135° with two per cent. of sulphur for an hour, and then mixing the very partially cured material with six to ten per cent. of sulphur, making up the required articles, and curing as in the case of rubber. Very hard vulcanized gutta may be made by incorporating a large proportion of sulphur, say thirty to fifty per cent., and curing, as for ebonite. Coloring matters may be incorporated, but the production of light tints is not so practicable as in the case of vulcanite from rubber.

Hancock's method of vulcanizing with a mixture of sulphide of antimony and sulphur yields an excellent result with gutta percha, six parts of the sulphide, one of sulphur, and forty-eight of gutta being good proportions. The curing requires a temperature of 135° to 140° Centigrade.

You see before you some very interesting specimens of vulcanized gutta percha, for which I am indebted to Mr. Walter Hancock. You will notice how perfect and sharp the detail on this medal is, it being difficult to imagine the original device better defined than this is.

It now remains for me to thank you for your attention during this course; and my best thanks are due to the numerous gentlemen who have co-operated with me in my work, not only by lending me the products of their factories, but also in allowing me to visit their workshops whenever I had occasion to do so.

Your thanks and my own are also due to Mr. Barker, who has so ably helped me in the task of demonstrating many points of interest, which, without his aid, would have been impracticable.

Information conveyed through the medium of a short course of lectures is necessarily very partial and fragmentary. The things which have been omitted are naturally more numerous than those which have been said.

PREPARATION OF OPIUM FOR SMOKING.

By HUGH MCCALLUM, Pharmaceutical Chemist, Government Analyst, Hong Kong.

As the policy of the opium trade from India to China is receiving considerable attention among philanthropists, etc., in England, probably the following account of the process of preparing opium for smoking purposes, as conducted by the present opium farmer in Hong Kong, may be of some interest to pharmacists.

The boiling operations are carried on in a moderate-sized building at Shek-tong-tsui, in the west end of the city of Victoria, where there are over eighty Chinese coolies and a few Indian watchmen employed, all of whom live on the premises. The majority sleep in a loft immediately above the boiling rooms, the others in a room on the ground floor, which also does duty as a kitchen, mess room, and general store, and is in open communication with the boiling rooms. The *employés* may, therefore, be said to live in an atmosphere saturated with the odor of opium, yet all seem in good health. On inquiring if many of them were habitual opium smokers, the information received was that only one headman smoked regularly, but that some of the others indulged occasionally when any of their friends paid them a visit.

The boiling is conducted in two rooms in open connection with each other, one being set apart for the first boiling, the other for the final. The first boiling room has a row of furnaces along each side, with a few rows running transversely between them; the other has four rows extending the whole length of the room. The furnaces are made of a kind of fire clay and are of two sizes, the large size having a diameter of about twenty-four inches, the small size a diameter of eighteen inches, the depth of each being about nine inches; they are built in with brick, the fuel used is wood charcoal. The pans in which the opium is boiled are made of some kind of copper alloy, and are of two sizes, so as to fit the furnaces, their shape being somewhat like a shallow evaporating dish.

The opium is sent every day from the hong (*i. e.*, shop or firm) to the boiling house, the previous day's boiling being then returned to the hong. The average quantity boiled each day is from six to eight chests of Patna opium, this being the only kind used.

The opium is removed from its covering of leaves, etc., moistened with a little water, and allowed to stand for about fourteen hours; it is then divided into pans, two and a half balls of opium and about ten pints of water going to each pan; it is now boiled and stirred occasionally until a uniform mixture having the consistence of a thin paste is obtained. This operation takes from five to six hours. The paste is at once transferred to a larger pan, and cold water added to about three gallons, covered and allowed to stand for from fourteen to fifteen hours. A bunch of tang suin (lamp wick, the pith of some plant) is then inserted well into the mass, the pan slightly canted, when a rich clear brown fluid is thus drawn off and filtered through chi mui (paper made from bamboo). The residue is removed to a calico filter and thoroughly washed with boiling water, the wash water being reboiled and used time after time. The last washing is done with pure water; these washings are used in the next day's boiling. The residues on the calico filters are transferred to a large one of the same material and well pressed; this insoluble residue, called nai chai (opium dirt), is the perquisite of the head boiling coolie, who finds a ready market for it in Canton, where it is used for adulterating, or rather in manufacturing, the moist inferior kinds of prepared opium. The filtrate or opium solution is concentrated by evaporation at the boiling point, with occasional stirring, until of a proper consistence, the time required being from three to four hours; it is then removed from the fire and stirred with great vigor till cold, the cooling being accelerated by coolies with large fans. When quite cold it is taken to the hong and kept there for some months before it is considered in prime condition for smoking. As thus prepared, it has the consistence of a thin B.P. or treacly extract, and is called boiled or prepared opium. In this state it is largely exported from China to America, Australia, etc., being carefully sealed up in small pots having the name of the maker (*i. e.*, hong) on each.

The Chinese recognize the following grades of opium: (1) "Raw opium:" as imported from India. (2) "Prepared opium:" opium made as above. (3) "Opium dross:" the scrapings from the opium pipe. This is reboiled and manufactured as a second class prepared opium. A Chinese doctor stated lately at a coroner's inquest on a case of poisoning that it was more poisonous than the ordinary prepared opium. (4) "Nai chai" (opium dirt): the insoluble residue left on exhausting the raw opium thoroughly with water.

What strikes one very forcibly on witnessing these operations is that the morphia value of the opium can have little to do with its smoking value, because, if so, the mode of manufacture must deteriorate it considerably, owing to the long-continued moist heat it undergoes; however, there can be no doubt but the process described has, after long experience, been found to yield the drug in the most approved form for smoking. This opinion naturally raises the question, Which of the definite principles of opium, or combinations thereof, has the power when smoked, or rather burned, in a pipe, the vapors being inhaled, of producing such peculiar effects? The elucidation of this point must be of great interest both to the chemist and physiologist.—*Pharmaceutical Journal.*

FREEZING MIXTURES.

By A. DITTE.

THE reduction of temperature observed when sodium sulphate is mixed with hydrochloric acid is not due simply to the solution of the salt. Double decomposition takes place in accordance with the principle of maximum work; sodium chloride is produced, and this, being insoluble in concentrated hydrochloric acid, is precipitated; the water which existed in the salt as a solid is set free as a liquid, and it is mainly this passage of the water from the solid to the liquid condition which causes an absorption of heat. If the hydrochloric acid be not sufficiently concentrated, a portion of the salt formed is dissolved, the decomposition is not complete, and the maximum reduction of temperature is not obtained. When sixteen parts of sodium sulphate are mixed with twelve parts of the commercial acid, the temperature of the mixture is reduced about 33°. Similar effects are produced with mixtures of sodium phosphate or sulphate with nitric acid, and the alums or sodium phosphate with hydrochloric acid.

Pure phosphoric acid may be easily obtained by saturating a solution of sodium phosphate with hydrochloric acid gas, decanting the clear liquid from the precipitated common salt, and distilling off the excess of hydrochloric acid. —*Compt. Rend.*

COMPRESSION OF GASEOUS MIXTURES.

By L. CAILLETET.

WHEN a mixture of air and carbonic anhydride is submitted to pressure, the liquefaction of the carbonic anhydride is often greatly retarded. Thus, a mixture of equal volumes of air and carbonic anhydride will support a pressure of 400 atmospheres at 0° without visible change. When, however, five volumes of carbonic anhydride are mixed with one volume of air, the former is easily liquefied. If the pressure be then raised to 150 or 200 atmospheres, the meniscus of liquefied acid, before concave and well defined, grows flat and indistinct, then it gradually becomes imperceptible, and the liquid at length disappears altogether. The tube then appears as if filled with homogeneous matter, which resists all further pressure as a liquid would.

When the pressure is again slowly diminished, the liquid suddenly reappears, at a pressure which is constant for given temperatures. A thick cloud appears in the tube, spreads, and vanishes as the liquid forms. The pressures at which the liquid carbonic anhydride reappears are at 5·5°, 130 atmospheres; at 10°, 124 atmospheres; at 13°, 120 atmospheres; at 18°, 113 atmospheres; at 19°, 110 atmospheres. Carbonic anhydride gas compressed beyond 250 atmospheres is not liquefied at 21°. It might be supposed that this disappearance of the liquid is apparent only in consequence of the refractive index of compressed air increasing more rapidly than that of liquid carbonic anhydride, so that at the point where the two indices become equal, the surface of the liquid would cease to be visible. But, in that case, the surface of separation should again become visible when the pressure is further increased. This, however, does not occur, and the author's conclusion is that under high pressures a gas and a liquid are capable of solution in each other, so as to form a homogeneous whole.—*Compt. Rend.*

NOTE.—The recent experiments of Ramsay on the so-called critical point of liquids (*Proc. Roy. Soc.*) would seem to require some modification of the above theory.—*C. E. G., in Jour. Chem. Soc.*

A NEW TRIAMIDOTRIPHENYLMETHANE (PSEUDOLEUCANILINE).

By O. FISCHER and J. ZIEGLER.

METANITROBENZALDEHYDE, when digested with aniline hydrochloride and zinc chloride at 100°, is converted into a new nitro-base, which is purified by means of its benzene compound, $C_{19}H_{17}N_3O_3+C_6H_6$. The latter separates from solution in benzene in the form of lemon-yellow crystalline groups (m. p. 81°). It is nearly insoluble in water, very easily soluble in ether and alcohol, less so in benzene, and only very sparingly soluble in light petroleum. The free nitro-base, $C_{19}H_{17}N_3O_3$, is obtained by heating its benzene derivative at 110° to 120°. It consists of pale yellow crystals (m. p. 136°), and on heating with an excess of methyl iodide and methyl alcohol at 110° to 115°, it gives the compound $C_{38}H_{41}N_3O_3.2MeI$, which crystallizes from alcohol in needles (m. p. 225°) with decomposition, the substance becoming green), and loses the whole of its methyl iodide at 200°. The residue appears to be converted into benzaldehyde green when oxidized with manganese dioxide and sulphuric acid (compare *Ber.*, 12, 802). The above methiodide is identical with the corresponding compound of metanitrotetramethyldiamidotriphenylmethane.

The nitro-base previously described gives triamidotriphenylmethane (pseudoleucaniline) when reduced with zinc dust and hydrochloric acid. The benzene compound of pseudoleucaniline ($C_{19}H_{19}N_3+C_6H_6$) crystallizes from benzene in white needles (m. p. 145°, with the previous evolution of gas). Pseudoleucaniline is obtained from its compound with benzene, by boiling with sulphuric acid until all the benzene has gone off, and then precipitating with ammonia. It crystallizes from ether on addition of a little light petroleum, in brilliant colorless rosettes, which are very apt to retain ether. After drying at 100°, it melts at 150°. It is easily soluble in alcohol, less so in ether, and scarcely at all in light petroleum. It forms a methiodide, which appears to be a monomethylated triamidotriphenylmethane, and cannot be obtained in the crystalline form. On heating at 200°, it loses its methyl iodide, and leaves a residue which, on oxidation, gives a dark green dyestuff. The *platinochloride* of pseudoleucaniline $(C_{19}H_{19}N_3.3HCl)_2.3PtCl_4$, is a yellow crystalline precipitate, which is very easily soluble in water, less soluble in alcohol, and still less so in ether.

Metanitrodiamidotriphenylmethane, on oxidation with hydrochloric acid at 150°, gives a fused mass, containing two dyestuffs, which are easily separated by means of water. The more soluble is violet, and the other, which is obtained in larger quantity, is green. Pseudoleucaniline, under similar circumstances, gives only a violet dyestuff, which is easily soluble in alcohol and water. By this means pseudoleucaniline is readily *distinguished* from paraleucaniline.—*Jour. of the Chemical Society.*

ETHEREAL OIL FROM THE CALIFORNIAN BAY TREE.

By J. M. STILLMAN.

THE leaves of the Californian bay tree (*Onodaphne californica*), when distilled with steam, yield nearly three per cent. of a clear, limpid, yellow oil, having a pleasant aromatic odor, but producing tears when strongly inhaled; sp. gr. 0·94 at 11°. By fractional distillation, it may be separated into terpinol $(C_{10}H_{17})_2O$, b. p. 167–168°, and *Umbellol*, $C_{10}H_{12}O$, b. p. 215–216°. V. d. = 4·39, calc. = 4·29.

Umbellol is a colorless limpid liquid, having a pleasant odor, but producing tears and headache when inhaled in larger quantity. It is insoluble in water, and but slightly volatile therewith. It dissolves in concentrated sulphuric acid with a blood-red color, which rapidly becomes black. It is strongly attacked by sodium or by concentrated nitric acid.

ABIETIC ACID.

By W. KELBE.

ABIETIC acid, $C_{44}H_{64}O_5$, is obtained by adding common salt to the solution of soda which has been used for the purpose of purifying crude rosin oil. The soap is dried at 70—80°, and extracted with ether to remove impurities; the residue dissolves in alcohol, and on evaporation the alcoholic solution deposits needle-shaped crystals of sodium abietate. On the addition of hydrochloric acid to the aqueous solution of the sodium salt, a white precipitate of abietic acid is produced, which melts to a resinous mass if the mixture is boiled. The acid is soluble in ether, benzene, alcohol, and glacial acetic acid, and is deposited from its solution in the latter solvent in triclinic plates (m. p. 165°). The pure salts of abietic acid form gelatinous masses with ether, but do not dissolve in it.

VALUATION OF BITUMINOUS ROCKS AND LIMESTONES.

By P. KIENLEN.

A STOUT glass tube, about 50 cm. long and 25 mm. diameter, is fitted at one end with a cork, the other end is blown out to a bulb, below which the tube is drawn out and furnished with a glass stopcock. The bulb is packed with asbestos or glass wool well washed and ignited, and 10 grammes of the finely powdered rock are introduced in alternate layers with pounded glass, so that the tube is about two-thirds filled. 50 c.c. of a mixture of equal volumes of carbon bisulphide and benzene are now added, and the tube is allowed to stand for an hour, when the strongly colored liquid is drawn off and the treatment repeated until the extract is no longer colored. Three digestions in the cold of one hour each are usually sufficient. The volatile liquid is carefully distilled off in a weighed flask, the residue dried in a current of air at the ordinary temperature and weighed. Some bituminous limestones from Lobsann (Alsace) contained 12–16 per cent. of bituminous matter, while some volcanic rocks from the Auvergne contained nearly 24 per cent. Sulphur may be estimated by fusing the finely powdered rock in a porcelain crucible with 4 parts potassium nitrate, 4 parts sodium carbonate, and 2 parts sodium chloride, extracting with water, acidifying with hydrochloric acid, and precipitating by means of barium chloride.—*Bull. Soc. Chim.*

A LOG JAM.

ON Thursday, May 24, a few logs got hitched in deep water below the eighty foot plunge of Rumford Falls, and before the river drawers could get their force at work a formidable array of logs was gathered at that point. By Sunday 3,000,000 logs were stranded up at Rumford Falls. The news spread far and wide, and on Sunday probably one hundred people visited the scene, which was quite exciting. A large force of drivers were at work clearing the drive, but a boom broke above and let down 1,000,000 more. The scene at the foot of the falls was well worth seeing. Logs were piled up in every conceivable tangle, some of them thrust thirty feet above the surface of the water, and extending over several acres.

But the most interesting spectacle was to observe the shooting logs at the foot of the first fall. Here the water is about forty feet deep, and the undertow is tremendous. As the logs at the surface were dislodged, those far below were relieved, and some of them were shot twenty-five feet into the air, as if projected from a columbiad.—*Lewiston Journal.*

OCEAN soundings made with what is known as Sir William Thomson's steel wire show that along the entire coast of California a depth of 1,500 fathoms or more is reached as near as within a distance of from twenty to seventy miles westward from the shores, the greater part of this sudden fall occurring in the last ten to fifty miles. At one hundred miles west of San Francisco the bottom is found to be over 2,500 fathoms deep. The bed of the ocean continues of a uniform depth greater than 1,500 fathoms until the Sandwich Islands are reached, the greatest depth being 3,000 fathoms, at a distance of about four hundred miles east of Honolulu, which great depth is maintained until within ninety miles of Honolulu; at fifty miles from that place the depth is 1,500 fathoms.

COLD AIR MACHINES.

THE importation of fresh meat from the United States has been so successful that speculators have turned their attention to other sources of supply. From Australia we now receive each year thousands of tons of tinned provisions; but the importation of uncooked beef and mutton has not yet been accomplished on anything like a considerable scale. Meat coming from the United States reaches the consumer about ten or eleven days after death, but at least five times that period must elapse between the death of a beast in Australia and the appearance of a leg of mutton or a sirloin of beef on an English dinner table. This, however, really presents very little difficulty. If only a carcass can be kept perfectly sweet and fresh for ten days, it can be kept for a couple of months by the same means. The principle involved is extremely simple. The meat is stored on board ship in rooms, through which is passed a current of dry air, at a temperature of 33° or 34° Fah.—a temperature, indeed, just insufficiently low to congeal the pieces. Meat can be kept for an almost indefinite period in a frozen state; but the process of freezing it very much injures it. The texture and color are deteriorated, much of the nutritious quality originally possessed by the meat is lost, and decomposition sets in with startling rapidity after thawing has taken place. None of these evils attend the use of low temperatures which do not freeze. The meat will keep sound for a very long time, and when removed to a warm temperature it does not rapidly decompose. It may be taken as granted that with the aid of cold air chambers meat can be imported from Australia in excellent condition. The demand for cold air has called into existence a class of refrigerating machinery which must not be confounded with ice-making machinery. To make ice is one thing; to supply a large volume of chilled air is quite another. To make ice first, and then to blow air over it to cool the air, is out of the question from an economical point of view. Rough ice might, of course, be stored on board ship for the same purpose, but then the air which passed over the ice would cease to be dry. The plan now in use is to surround the meat room with double walls, and to stow ice all round, above and below, a small fan being used to keep the air changed; but an enormous quantity of ice would have to be carried to provide for an Australian voyage, and the cost of freight for this would most probably run away with the whole of the profits. For this reason, and for others, cold air machines are now being introduced, and two firms are specially employed at present in their construction; one is Messrs. Hicks, Hargreaves & Co., of Bolton, and the other is Messrs. Hall, of Dartford. Our purpose now is to explain the principle on which it operates.

When air is compressed rapidly it rises in temperature. If allowed to expand again at once it will regain its original temperature without loss. If, however, the compressed air be cooled down, and then allowed to expand, it will, roughly speaking, be cooler than it was before it underwent cooling and expansion, in proportion to the number of degrees of heat abstracted from it in the cooler. It is for our present purpose unnecessary to give any minute calculations; approximate figures will be quite sufficient. Now, nothing can be easier than to provide a large supply of cold air by causing a pump worked by a steam engine to draw in air at the atmospheric temperature and pressure, and deliver it through the tubes of a small surface condenser, from which it may escape under a loaded valve into the meat chamber. When expanding it would produce cold, to use a popular phrase. The objection to this arrangement is that the whole of the power expended in delivering the air under pressure would be wasted. In the machines now being made much of the loss is avoided by making the pump deliver its air into a cylinder in which works a piston which helps the steam engine, operating on a crank on the same crank shaft. Thus we have a compressing piston—driven—at one end of the crank shaft, and an expanding piston—driving—at the other end, and between the two comes the steam engine, a flywheel rendering the motion steady. In work, the compression piston first draws air into the cylinder, and then on its return stroke delivers it into the cooler. From this it is taken by the expansive cylinder, in which it is cut off at, say, one-fourth of the stroke, and expanded the remainder, and then delivered into the meat room. The whole arrangement of the air cylinders is not unlike that of a compound engine. The compressing pump answers to the large steam cylinder; the expansive cylinder finds its analogue in the high-pressure cylinder, the surface condenser acting the part of the receiver between the two. It might, perhaps, be supposed that with such an apparatus no great degree of cold can be obtained. To settle this point at once, we may say that the machine now at work at Messrs. Hall's, taking in air at 65° Fah., delivers it at the rate of 15,000 cubic feet per hour at a temperature of —50° Fah.—that is, 50° below zero. In the meat room various sources furnish heat, but with such a supply of cold air as this there is no difficulty in keeping a very large chamber at the proper temperature.

It is not very difficult to calculate the power required to produce any given result in this way. If our readers will turn to Clerk-Maxwell's treatise on thermo-dynamics they will find the whole theory involved set forth. Professor Cotterill has also investigated the subject, and it has been very fully dealt with on a specially mathematical basis in our own pages. Mr. D. K. Clark, in "Rules, Tables, and Data for Mechanical Engineers," supplies all the practical information needed in his chapter on compressed air engines, and to these sources of information we must refer such of our readers as desire to go further into this subject. It will suffice to say here that dealing with moist air, as the machine does, the initial temperature of the air being, say, 63° Fah., and the compression fivefold, the temperature would rise to about 167°, and the work expended in compressing each one pound of air would be about 52,500 foot pounds. If the air were quite dry the temperature reached would be 383°, and the work of compression would be 58,500 foot pounds per one pound of air compressed. As the air used is never quite dry or fully saturated, a temperature between these two should be attained, and in practice this is found to be the case, the air rising to about 300° in the compressing cylinder at Messrs. Hall's. The absolute temperature of the compressed air will then be $200° + 461° = 661°$. This is cooled down by the refrigerator to about $110° + 461° = 571°$ absolute. After expanding down to atmospheric pressure this air will have an absolute temperature of about 408°, and its sensible temperature will be —53°. Theory in this respect coincides very closely with practice.

The work done by the air in expanding may be found by the formula $W = 183{\cdot}4\,(T - t)$; that is to say, it will be equal to the fall of temperature multiplied by the specific heat of the air in foot pounds. The loss is the difference between 110°, at which the air was delivered to the cylinder, and —53°, at which it left it, or 163°, and $163° + 183{\cdot}4 = 29{,}899$ foot pounds per one pound of air. When we come to deal with diagrams taken from Messrs. Hall's expansion cylinder, we shall show how far this theoretical deduction is borne out in practice. The theory assumes, be it remembered, that we are dealing with dry air. M. Piccard gives figures which go to show that when air is compressed, cooled in a receiver, and then expanded, its efficiency is = about 55 per cent., that of compression being = 1. Applying this to the figures we have already given, we have $52{,}500 \times 55 = 28{,}875$ foot pounds per pound of air expanded, which agrees very fairly with the results obtained by a somewhat different form of calculation. It appears accordingly that of the whole power expended in compressing the air, an amount may be got back by the expansion expressed by the ratio of 28,000 to 52,000, or, let us say, in round numbers, one-half. M. Mallard, in his "Etude Théorique sur les Machines à Air Comprimé," has shown that the fall of temperature in wet compressed air, brought about by expanding it, is much less than that which takes place when dry air expands, and this fact ought not to be forgotten. It is obvious that, if no loss of heat took place, the work of expansion would be the exact counterpart of the work of compression, but the loss of heat represents so much loss of mechanical efficiency.—*The Engineer.*

THE ONE-HUNDRED TON GUN.

ON September 13 the one-hundred ton gun and the model *emplacement* in which it is mounted at the proof butts in the Government marshes adjoining the Royal Arsenal, Woolwich, were the objects of experiment, and the novelty as well as the importance of the occasion created considerable interest, as was manifested by the large number of officers and other visitors present. The recently-appointed Inspector-General of Fortifications, Major-Gen. T. L. J. Gallwey, R.E., superintended the arrangements, assisted by Col. W. Hatt Noble, R.E., Inspector of Works at the Royal Arsenal; Col. Eardley Maitland, R.A., Superintendent of the Royal Gun Factories, Royal Arsenal; and Capt. Morley, R.A., Proof Officer; while there were among the spectators Major-Gen. S. E. Gordon, R.A.; Major-Gen. Fisher, R.A.; Admiral Boys; Col. J. Inglis, R.E.; Col. MacFarlane, R.A.; Capt. C. Bridge, R.N.; Col. Alderson, R.A.; Capt. Fairfax Ellis, R.A., Secretary of the Ordnance Select Committees; Major Porter, R.A., Royal Gun Factories; Major E. S. Gordon, R.A., Royal Carriage Department; Capt. O'Brien, R.E., Works Department; Capt. Courtney, R.E.; Col. O'B. Woolsey, R.A., Instructor in Artillery Studies; Mr. R. S. Fraser, Royal Gun Factories, and Capt. Jones, R.A., Royal Military Academy, Woolwich. The great gun, whose actual weight is one hundred and one tons, was half hidden behind a parapet which appeared to be masonry, but proved on examination to be built of concrete. The parapet was about ten feet high, but as the gun was elevated upon its slide and carriage with an under trolley on racers to assist in turning it upon its axis, a portion of it was always visible above the works, over the whole circumference of which, had they been complete, it would have swept *en barbette*. The sham fortification was, however, but half constructed, principally in order that it might be seen in sections, and the apparatus, which will be hidden in practice, be open to examination. It was explained that the four one-hundred ton guns purchased of Sir William Armstrong some two years since are to be mounted on the defenses of Malta and Gibraltar, and that as it has been considered desirable to load them by hydraulic machinery, this experiment had been proposed in the hope of gaining some experience before proceeding extensively in permanent preparations. Gen. Gallwey will proceed to the Mediterranean stations very shortly to superintend what has been already begun there, and an officer of the same department, with copies of the plans of the Woolwich model, has preceded him to set about the foundations. Elevated as the gun was, and pointed over the glacis of the parapet, it presented a most commanding aspect, and has probably never appeared to such advantage. More than thirty-four feet long, with a diameter at the breech of six feet six inches, tapering gradually off to two feet six inches at the muzzle, it had a more slender and less sturdy outline than that of the natural system of heavy ordnance, but its admirers praised it as the combination of strength and elegance, and claimed for it the advantages due to the saving of weight and metal. Size and weight appeared of no consideration at all when a lever was touched, and the bulky breech rose and fell as the muzzle was elevated or depressed with no more apparent effort than a nine-pounder requires at the hand of a gunner; and the admirable adjustment of the machinery when the whole mass swept grandly round to the opposite point of the compass was unanimously confessed. Then the order was given to load. A small elongated carriage or cradle stood on a miniature railway close at hand, and upon this were placed two cartridges and the shot. The charge was four hundred and twenty-five pounds of pebble powder, and it was made up into two cartridges for convenience of carriage; but a tube ran through both, and just at the point of communication a small primer of small grain powder had been inserted for the purpose of igniting the charge in the center. The projectile was a huge bolt seventeen and three-quarter inches in diameter, and nearly three feet long, its weight being, with the gas check attached, 2,020 lb., or nearly a ton. The cradle with its burden ran along the rails, and entered an iron turret about twelve feet in breadth. One side was an open fort, to which the muzzle of the gun on the outside descended. On a turn-table in the center of the apartment the cradle revolved, bringing the charge close up to the muzzle of the gun, when out from the other side rose the head of the rammer, and drove cartridges and shot into the mouth and rammed them well home. The rammer, which was a six-inch piston fifty-four feet in length, is moved by hydraulic rams with a four-foot stroke and multiplying gear, and it descends through a tube into the earth. The monster gun as soon as it was loaded was elevated clear of the parapet, and trained about 15° to the left, which brought it exactly opposite to one of the sandbags at the butts, the act of moving the gun at the same time automatically closing the iron door of the loading port, which is in like manner opened by the return motion. The gun is to be fired through the axial vent, and the electric wire is passed through an arrangement of copper disks which have been contrived with the long-desired object of effectually closing the vent and saving the evil consequences which arise from the escape of powder gases. The spectators withdrew to a safe distance, and after an interval of suspense an appalling roar, which makes the earth vibrate, is heard and deadens the senses for a time, and the enormous gun is observed calmly sliding down from the recoil amid a cloud of smoke, dirt, and *débris*. The first anxiety was to examine the structure, and the inspection was perfectly satisfactory, for nothing whatever had suffered from the discharge, and the durability of concrete even for real fortifications had become a subject for consideration. In this work upwards of 3,000 tons of concrete has been used, about half of which is below and half above the ground, the lower half being compounded of cement and Thames ballast, and the upper half of cement and furnace slag. The latter was prepared with great labor, owing to the difficulty of crushing the refuse metal, and it is believed that it would stand a fair cannonading as well as the famous Gozo coraline with which the Maltese works are constructed. The hydraulic lever at the Mediterranean forts will be furnished with an arrangement similar to that used in the experiments—an accumulation weighted up to sixty-seven tons, with a sixteen-inch ram and an eight-foot stroke. This can be raised by a steam sapper, or traction engine, in one minute, or forty men can pump it up by hand in seven minutes. The one round fired as described is but the first in a series of experiments of a similar character, and it will be some time before the gun leaves Woolwich for its final destination in one of the Mediterranean fortresses.—*London Times.*

SAFETY HOOKS.

BY A MINING ENGINEER.

WITHIN the last two years the adoption of safety hooks has become much more common, and within the next two it is to be hoped that every one who is connected with works where the introduction of some of the various safety

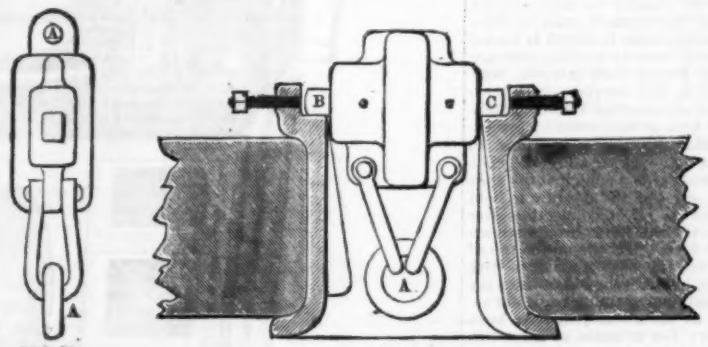


FIG. 1. FIG. 3. FIG. 2.

BOOTH AND SUGDEN'S HOOKS.

appliances might be the means of saving both human life and property may be convinced by their use and ultimate good results, which can only be brought to light by their general adoption, that to be without them would, to say the least of it, be an error of judgment.

The opinion has been advanced that the fact of any safety apparatus being applied has the tendency to cause the person in charge of the machinery over which the apparatus is placed to become less careful than he would otherwise be; but this we deem to be a slur on the character of a class of men who are only chosen for such positions on account of their known and proved steadiness, ability, and intelligence. Even though the adoption of safety hooks at all collieries were made compulsory the fact is still evident that were the cage to be overwound the hooks might fail, but not probably; and it would most certainly lower the engineman's status in the eyes of his employer were an accident to take place; while in case of an accident occurring, and especially were any lives lost, he might have to forfeit his situation. Many men after causing the death of a man through overwinding would not be fit to be trusted longer with the lives of others; the shock they would naturally receive would have such an effect on the system as to totally unfit them for the position, if not altogether, at least for some considerable period to come. In a paper recently read before the members of the North of England Institute of Mining and Mechanical Engineers it was stated that out of 178 deaths caused through overwinding during the last quarter of a century, 98·88 per cent. of these lives lost might have been saved by the adoption of efficient safety hooks or other appliances. The majority of these deaths, or 62 per cent. of them, have been caused by the engineman being at fault in not stopping the engine at the proper time. Through the deficiency of applied safety hooks 2·25 per cent. of the deaths caused was the result. In the case of all detaching hooks their patent only comes into action after the fact that an overwind has occurred; and there is yet to be invented something that will have the effect of preventing the cage too nearly approaching the pulleys, and destroying the momentum of the moving load so that it will not have the tendency to continue its upward course, causing slack rope to lie on the cage top, and then to descend through its own weight, breaking the rope, and so going to the bottom, unless the cage be provided with some apparatus to prevent its so doing.

Some experiments were made to test the materials of

which the hooks are composed, the plates of one of three hooks so tested being made of best Staffordshire iron, those of another of Landore-Siemens steel, and the third of Bowling iron. The plates were 1 inch thick, shackles 1¾ inches in diameter, and in all other respects the hooks were similar to each other. The hook of best Staffordshire plates broke off at 21 tons, that of Landore-Siemens steel at 45 tons, but with the Bowling iron that portion of the hook in tension tore away at a strain of 54 tons sufficiently to allow the shackles to slip away. In a lecture delivered at the Wigan Mining School by Mr. C. M. Percy on "Winding and Overwinding," and which is well worth perusal, the author states the following to be the requirements of a good detaching hook:

1. Strength, not only sufficient to maintain the load, but to sustain the shocks to which they are liable to be exposed.
2. Not liable to detach during ordinary working. This is achieved by having the pull of the rope and the pull of the load acting in one vertical line.
3. Certain in action in a case of overwinding, the action being of two parts—to detach and to clutch the support, to prevent the load going back.
4. No pieces that can come loose so as to wedge any part and prevent detachment when needed, or slip down and cause detachment at the wrong time.
5. Easy reattachment, and safety whilst so doing. This can only be accomplished by having catches supporting the cage in such a position as to throw some slack in the cage chains.

The principle of this hook will be seen from the following description on referring to drawing on preceding page: A A is the shackle, to the upper part of which the rope is attached, the cage being fastened to the ring below at the lower part of the hook. A box is secured by the usual D links to the socketing at the bottom of the winding rope, and to the cage chain in this box the hook to be released is fastened, the box being shaped out to receive the same. In the hook there is a rectangular hole shaped out, in which a stud, B, is placed, being 1⅝ in. by 1¼ in., and is kept in position by means of two soft metal pins; this stud carries the load, and has a bearing on each side of the box in which it is placed. Below the hole a wedge-shaped projection is placed on each side of the hook, having the thicker end toward the bottom. There is another similar stud, C, placed immediately opposite the bearing stud, B, and in the same line with it, being a forcing stud, and is only used to disengage the stud, B, which bears the weight. The end of the forcing stud, C, projects outside the box, while the whole of the bearing stud, B, is placed within the box. The stud, C, is also kept in position by metal pins. The disengaging bracket is fixed to beams of oak immediately under the pulleys, and the rope passes through it. The bracket is of cast iron, and is constructed to receive the box, and has one side made in the form of an inclined plane, and on the other side a corresponding projection. This is so arranged that when the hook is drawn through the orifice, as in case of overwinding, the projecting part of the forcing stud, C, is forced into the hook through its coming in close contact at its outer end with the face of the inclined plane until its inner end comes against the bearing stub, B, which is forced outwards, and in doing this both sets of holding pins are sheared. When the stud, C, is forced fully inwards, both studs are then flush with the hook, and the ends of the two studs form together the shape of an inverted V immediately over the shackle. The box is held at this point by projections, which prevent it from going through the aperture, so that the hook is drawn through the V, separating the ends of the studs and forcing them outwards a sufficient distance to project far enough over the sides of the aperture to hold the cage in position. In order to effect connection after disengagement has taken place, the shackle is brought down and slid into the hook; the two forcing screws on the top of the orifice are screwed in, forcing the two studs flush with the hook, and upon lowering the hook through the orifice the studs are forced back to their original position ready for recommencing winding as soon as the metal pins have been inserted. It requires but a very few minutes to carry this out, as the weight of the load is utilized in making the connection. Partial overwinding cannot take place, as the shackle cannot become disengaged without securing the hook. There is no fear of disengagement occurring through anything falling down the shaft and striking the hook, as the stud which carries the load is entirely placed inside the hook. The shearing strain in disengaging is reduced to a minimum, as it is done gradually and not instantaneously, and thereby causing no undue strain on the rope. The hook is made of steel and weighs about thirty-eight pounds, being suitable for a safe working load up to five tons, its ultimate breaking strength being sixty tons. It is very easily taken to pieces and overhauled, and the price the moderate sum of £10 per hook. This hook, which was only patented toward the end of last year, has not yet come to notice, and its principles of construction and action differ materially from the majority of safety hooks. The following are its advantages:

1. The load is not on the part where disengagement occurs.
2. Partial overwinding cannot take place.
3. All risk of disengagement from anything striking the hook when in the shaft overcome.
4. Shearing strain in disengagement reduced to a minimum.
5. No tendency to release the load or draw it through the aperture after overwinding takes place.
6. The short time required for its reconnection.—*Colliery Guardian.*

CONSOLIDATION LOCOMOTIVE FOR THE PHILADELPHIA AND READING RAILROAD.

Our engraving and the smaller view on next page represent one of the heavy freight engines recently built for the Reading Railroad by the Baldwin Locomotive Works, of Philadelphia.

These engines have the Wootten fire-box, for burning fine coal. It extends laterally over the frames and back pair of driving-wheels, so as to be 8 ft. wide inside.

The following are the principal dimensions of these engines:

Cylinders, 20 in. diameter × 24 in. stroke.
Driving-wheels, 50 in. diameter.
Truck-wheels, 30 in. diameter.
Driving-wheel base, 14 ft. 9 in.
Total wheel-base, 23 ft. 10 in.
Fire-box, 114 in. long × 96 in. wide.
Smallest diameter of boiler, 56 in.
197 tubes, 2 in. diameter × 11 ft. 6⅛ in. long.
Heating surface in tubes, 1,190 sq. ft.
Heating surface in fire-box, 167 sq. ft.
Heating surface, total, 1,357 sq. ft.
Grate consists of water-tubes and cast-iron bars.
Driving-wheel journals, 7 × 8 in.
Truck-wheel journals, 5 × 8 in.
Steam-ports, 16 in. × 1¾ in.
Exhaust-ports, 16 in. × 2½ in.
The boiler is fed by two No. 8 Sellers injectors.
Capacity of tank, 2,800 gallons.
Diameter of tender-wheels, 30 in.
Journals of tender, 3⅞ in. diameter × 8 in. long.
The fire-box slopes downward and is stayed on top and sides with stay-bolts.
The engines also have feed-water heaters, which are shown under the running board.

The excellent performance of this engine will be seen from the following accounts of recent trial trips:

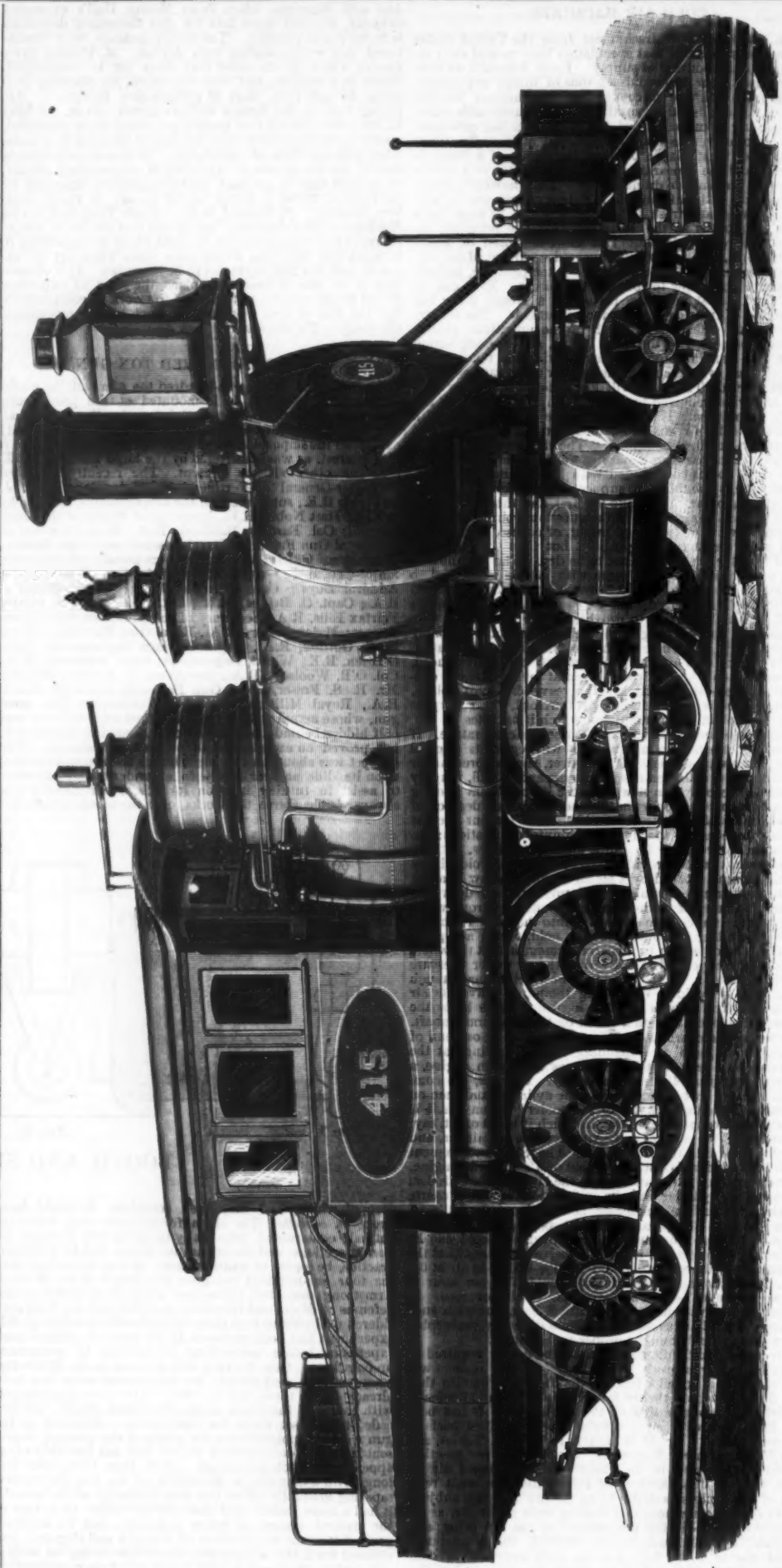
A trial trip of one of these locomotives in ordinary freight service on the "Bound Brook Line," between Philadelphia and New York, 22d June, 1880.

The locomotive left Third and Berks streets depot, Philadelphia, at 9 A M., empty, and at Fairhill Junction took on fifty loaded four-wheeled cars, at Jenkintown took thirty more, and at Bound Brook added twenty more, making a train of one hundred loaded four-wheeled cars, with which it arrived at Elizabethport at 5 P.M. The tank was full of water on leaving Philadelphia and was refilled three times.

Fairhill Junction to Jenkintown, maximum grade, 58·6 feet per mile; train, 50 loaded four-wheeled cars.
Jenkintown to Bound Brook, maximum grade, 87 feet per mile; train, 80 loaded four-wheeled cars.
Bound Brook to Elizabethport, maximum grade, 23 feet per mile; train, 100 loaded four-wheeled cars.

Quantity of water consumed ... 7,747 gallons.
Whole time on road ..... 8 hours.
Actual running time with train, Fairhill Junction to Elizabethport ..... 5 hours 43 minutes.
Weight of each loaded car..... 8 11-20 gross tons.

Returning, the engine left Elizabethport with 119 empty



CONSOLIDATION LOCOMOTIVE, WITH WOOTTEN'S FIRE-BOX FOR BURNING FINE COAL.
Built for the Philadelphia & Reading Railroad Company by the Baldwin Locomotive Works, Philadelphia.

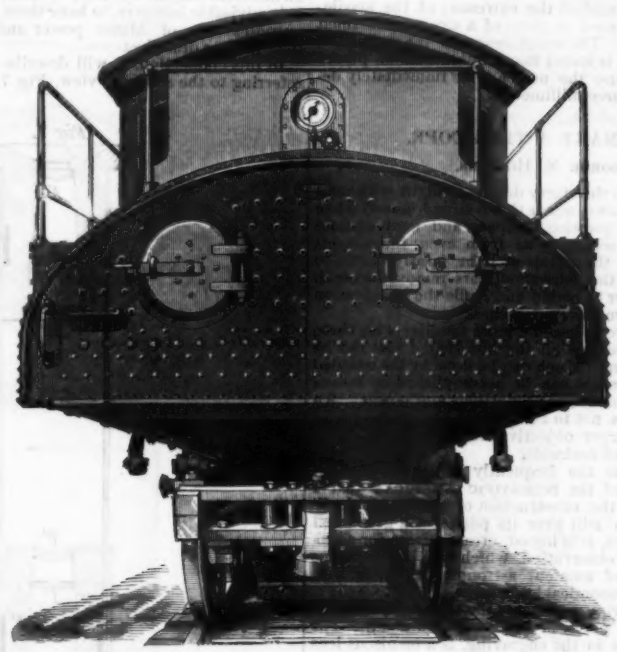
four-wheeled cars at 6 P.M., and arrived at Third and Berks streets, Philadelphia, at 12:10 P.M. The tank was full of water on leaving Elizabethport and was refilled three times.

Quantity of water consumed	6,215 gallons.
Whole time on road	6 hours 10 minutes.
Actual running time, Elizabethport to Philadelphia	4 hours 32 minutes.
Maximum grade of road	37 feet per mile.
Weight of each empty car	3 3-20 gross tons.

SUMMARY.

Distance (77½ miles each way)	155 miles.
Total weight of coal consumed in round trip, including firing up	13,900 pounds.
Coal consumed in firing up and in furnace at end of trip, estimated,	950 pounds.
Coal consumed in making round trip	12,950 pounds.
Total quantity of water consumed in round trip	13,962 gallons.
Pounds of water evaporated per pound of coal	8·98

The engine steamed very freely all the while. The safety valve, set at 127 pounds, blew off frequently when running although the engine ran much of the time with the register in smoke-box front open and with the furnace doors open. When coming to stations the pressure was reduced to 100 pounds by opening the furnace doors, and in a few minutes after closing the doors the pressure would rise to 127 pounds. The engine made very little smoke or cinders, and at night very few sparks were noticeable.



BACK END VIEW OF CONSOLIDATION LOCOMOTIVE.

A run was made August 17, 1880, with Consolidation engine No. 417, of the Philadelphia and Reading Railroad Company, from Fairhill Junction to Elizabethport and return, using Youghiogheny bituminous coal. The performance was as follows:

EASTWARD TRIP.

Train, Fairhill Junction to Jenkintown	56 loaded four-wheeled cars.
Train, Jenkintown to Elizabethport	81 " " "
Quantity of water used,	7,865 gallons.

WESTWARD TRIP.

Train, Elizabethport to Fairhill Junction	112 empty four-wheel cars.
Quantity of water used,	6,297 gallons.

SUMMARY.

Total weight of coal consumed in round trip, including firing up	13,808 pounds.
Coal consumed in firing up	1,275 "
Coal consumed in making round trip	12,533 "
Total quantity of water used in round trip	14,162 gallons.
Pounds of water evaporated per pound of coal	9·41

FAST PASSENGER LOCOMOTIVES.

IT has been said of human progress that it moves in a circle Some shrewd observer has corrected this by saying that it advances in a spiral; that is, its path, looked at in one way, is in a circle, but at each revolution it moves upward or forward in relation to the position it occupied before Any observer of the advance which has been made in railroads will notice that it has very much of this spiral movement. Thus twenty-five years ago there was a great demand for faster speeds on what were then the principal railroads in the country. Time tables were then made which required very nearly as high rates of speed as any of the present day. The cars of that time were, however, very light compared with those in use now. Sleeping cars were used only to a limited extent, and drawing room cars were unknown. The financial collapse of 1857 so crippled the railroads and the general business of the country that the fast trains were then abandoned, and it is only within the past few years that the demands of the public and the competition of different lines have led to the adoption of speeds equal to or greater than those of the date referred to.

Besides the fact that the weight and number of cars of each train have been increased since then very greatly, the great many engines with a single pair of large driving wheels from 6 feet to 9 feet in diameter have been built in this country and in Europe. Here such engines have, however, universally failed, and at the present time none of that kind are in use on this side of the Atlantic that we know of, and in Europe they are no longer regarded with much favor, although many of them are still used.

We may naturally then ask what is the cause of their failure. Perhaps the answer may become apparent if we examine into the work which an engine running a fast train must do. If the latter consists of a dozen or fifteen cars, as it often does, which are standing still, the engine must of course put them in motion. Their resistance or the strain on the draw bar will then depend upon the quickness with which they are started. Thus if the power employed to move them was exerted by means of a screw and was applied very slowly and regularly, very little more force need be exerted to start them than is required to keep them in motion after they are started. Suppose on the other hand that a cannon were placed on the track behind the train, and that a 15 in. shot were fired so as to strike the buffer; obviously the resistance of the train to moving as rapidly as the shot would be so great that the materials of which the cars were made could not resist it, and they would be shivered to pieces. Now between these two degrees of resistance the latter varies, and a locomotive may always exert its maximum tractive power in starting a train, even though the latter is comparatively light.

Nor is this all. After the train is started, if fast time is demanded, its resistance will depend upon the rate of acceleration. If—in the language of train men—"you get up speed quickly," the resistance or pull in the draw bar will be correspondingly great. It therefore happens that in starting a train and in getting up speed an engine will nearly always have occasion to exert its maximum tractive power. If it has a single pair of wheels, it will have comparatively little adhesion, and as the tractive force which it can exert is dependent upon the adhesion, the start and acceleration of speed must be comparatively slow with that kind of engine, and therefore it becomes difficult to make fast time, for the lack of adhesion.

The condition under which an engine must work, when it has only a single pair of driving-wheels and therefore comparatively little adhesion, is analogous to that which would be experienced in drawing a wagon rapidly with a weak string. In such a case, obviously, it would be necessary to start very gently and increase the speed slowly, for fear of breaking the string. If a locomotive has little adhesion it must also be started gently; otherwise it will lose its hold to the track.

It may therefore be concluded that a deficiency of adhesion is a defect with all engines having a single pair of driving-wheels, even when there is an appliance for increasing and diminishing the load on them. This latter device has been tried repeatedly, but thus far unsuccessfully.

To get over the defect of insufficient adhesion, it might naturally be expected that resort would be had to coupled wheels, and to get the required speed these might be increased proportionately. There are, however, very grave objections to the use of large wheels. In the first place, their weight is somewhat in proportion to the square of their diameters. They require larger axles, larger cylinders, pistons, connecting-rods and frames, and, in short, the whole working machinery of the engine must be larger and heavier. To show what the effect of this will be, let it be supposed that the weight of an engine must be limited to thirty-five tons, or 70,000 lb. It is obvious that the weight of its boiler cannot exceed the whole weight less that of the working and other parts which form the locomotive. In other words, the larger and heavier the wheels, axles, cylinders, frames, connecting-rods, etc., are, the lighter and smaller must be the boiler. What is added to the weight of these parts must be taken away from the boiler, so that an engine of a given weight, with big wheels and cylinders, cannot have so large a boiler as one with small wheels.

Besides this the center of gravity, if large wheels are used, must be thrown up higher, and the engine is consequently more unsteady than it would be if it were lower. The distance apart of large driving wheels is also governed to some extent by their size. When this is excessive, it involves long coupling rods with a consequent increased liability to breakage.

Now, if instead of increasing the speed by enlarging the diameter of the driving wheels, the same object is attained by increasing the number of strokes of the piston and revolutions of the wheels, none of the evils pointed out will be encountered. As has been pointed out in these columns before, there is never any difficulty in turning the wheels fast enough to run at any desired speed. The trouble is in the movement of the reciprocating parts. The speed of the pistons limits the number of their strokes. If their stroke is diminished, the speed is reduced in the same proportion. and the same relative cylinder capacity may be retained by increasing their diameter. There is no reason why the latter may not be equal to or even exceed the stroke, and in fact in marine engines it often does. A shorter stroke than is ordinarily used also has the advantage that it reduces the relative amount of surface exposed to radiation, although an increase of the diameter of the piston adds to its weight.

Let us sum up then: To increase the diameters of driving wheels the size of boilers must be diminished, and the center of gravity of the engine be raised up, and in some cases the coupling-rods must be lengthened. Increasing the size of the wheels and other parts adds to the cost of the engine, and diminishing the boiler makes it less economical of fuel.

On the other hand, to reduce the stroke and increase the number of strokes diminishes the surface of the cylinders, lessens their cost slightly, keeps the center of gravity of the engine low, and in some classes of engines makes it possible to shorten the coupling-rods, and diminishes the amount of overhanging weight.

Let some of our locomotive superintendents who are called upon to provide engines to run fast and heavy trains adopt five-foot wheels, and cylinders 18×18 inches with an efficient valve-gear, and the largest boiler admissible, and it is believed that the working of such engines would be more satisfactory than that of one with larger wheels and longer stroke cylinders. An 18×18 inch cylinder has slightly more capacity than a 17×24 inch. The contents of the spaces swept through by the pistons is 5,581 and 5,448 square inches respectively.—*Railroad Gazette.*

WHEN THE TIMBER IS GONE, WHAT?

A FAVORITE question among political economists whose attention has been more particularly called to forest products, has been: What substitute shall be adopted when the building timber is gone? It is scarcely sufficient to reply that the world having existed for many thousands of years without approaching to a timber famine, it can continue to exist for thousands of years to come, during which period ample timber resources will be available for all the wants which may be developed. The conditions of growth and requirement have changed so rapidly that it may be boldly asserted that the consumption of timber has been practically confined to the past two hundred and fifty years, by which assertion we would be understood that up to that period the drain upon the forests was not of that systematic and exhaustive character which has marked the subsequent period of time. In fact so far as exhaustion is concerned, we feel safe in asserting that the drains upon the forest growths of the civilized world have been practically confined to the present century, the previous consumption of wood amounting to scarcely a greater percentage than would naturally have gone to decay, and being fully compensated for in yearly accretions by natural growth.

The present century, however, has developed a necessity for the use of forest growths, which in turn has stimulated the adaptation of machinery in its production, each adding facility for its preparation, but stimulating the demand for consumption, until within the past fifty years the forests of the old as well as the new world have been decimated by the woodman's ax, and have disappeared like the snowflake before a summer's sun. It is undeniable that at the present rate of consumption—and the certainties but point to its increase—the forests of white pine timber, which would require centuries of solitude and quiet for their reproduction, already show their utmost limits of yield to be within, at furthest, a period embraced in the life prospects of the middle-aged men who are now engaged in their destruction. What substitute shall we employ when the forests no longer yield to us their treasures of timber? In the days of Queen Elizabeth there was erected a building of wood on old London bridge which was a marvel of architecture and a model of house building in wood. This was the old Palace Nonsuch, four stories in height, made in Holland, and erected upon the bridge with wooden pins for holding it together. The buildings previously erected had been principally low structures, the spaces between the framing being filled in with clay, straw, stones, or reeds and plaster, or with brick and mortar, which had been known as a building material for many ages, but was in demand only for the dwellings of the wealthiest classes. The great fire in London, 1666, brought these inflammable materials into a large measure of disrepute, and the more general use of stone and burned brick was the result. The carpenter still visited the forest and hewed out the timber which was to form the beams, joists, and floors of the new buildings, which in the absence of saw mills, was but a slow and expensive practice. In fact, the majority of the buildings being but one story in height needed no floors, these being made of clay or brick, while the smaller poles of the forest amply sufficed for

rafters upon which to secure the covering of thatch. Wood was substituted as soon as the art of preparing it became more generally known, but the lofty four story buildings of a later age became possible only through the discovery of facilities for so cutting and preparing timber, by the whipsaw, the water mill, and the more adaptable machinery of the present generation, as to render its use convenient and feasible.

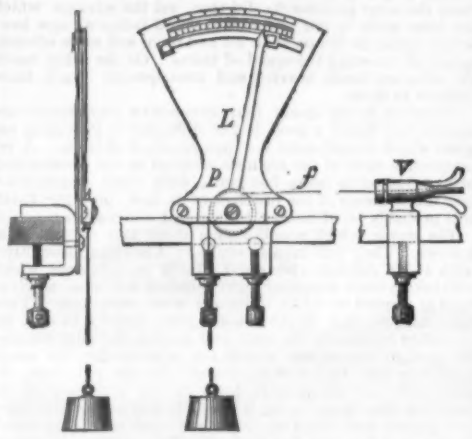
But as the adaptations of machinery in the manufacture of wood have rendered practicable the building of compact cities, so also has the attendant blessing introduced an element of danger which has led—even in the days of plenteous wood supplies—to the development of other materials which are to-day better known and more extensively utilized in the erection of large buildings than was manufactured wood one hundred and fifty years ago, and we are not sure but that we might safely say one hundred years, so that to-day it is no strange sight to behold a building of magnificent proportions in which wood products are noticeable only in their entire absence. Stone, iron, plaster, and brick may be combined for walls, joists, and floors, while iron and terra cotta form a substantial and fire as well as water proof roof; iron window frames in iron casings are abundant support for the glass which admits the light; while terra cotta and marble, or even iron, makes an ornamental floor, leaving but the doors to be provided out of the products of the forest. Should the metal or stone floor prove too chilling for the sensitive natures of the hot house plants, which we have reared in luxury to enjoy our palatial surroundings, the paper maker comes to our aid with the products of the straw of the agricultural fields, and covers the stone with a product equal for this purpose to wood, and fully as ornamental; the upholsterer decorates our windows and walls with the product of the cotton field or the wool of the sheep, three substances which the extravagance of man can never exhaust, and our mansion is fireproof, elegant, substantial, and devoid of wood, except as to the doors, which the paper maker even now stands ready to supply. Iron and stone, with their sister companions, brick, terra cotta, and paper, now form no inconsiderable factors in the building world, and we venture the assertion that the passing way of the era of wood will not be seriously felt by the generations which will succeed this, in so far as house building is concerned.

Iron is already a formidable rival of wood, and in connection with stone and clay, through the introduction of machinery for their cheap and ornamental manufacture, can now be produced so as to enable the erection of dwellings equal in appearance and scarcely more expensive than the ordinary dwelling of wood. Terra cotta, constructed in hollow cubes, can be laid up so as to present a double wall giving a single or double air space, making walls at once as warm, fully as durable, and at as little expense, or very nearly so, as in the use of wood. Furring and lathing of iron has been acceptably tested, as have light iron beams and rafters. Terra cotta roofs are almost universally employed upon the most expensive buildings, and the material may be procured sufficiently porous to hold the nail which confines an outer covering of slate or corrugated iron, or may be glazed to form a perfectly water tight surface if desired. Tiling is generally adopted for roofs in many countries. Glass, paper, and terra cotta, have been successfully employed in square or oblong blocks for flooring, laid upon iron joisting. Of these the paper and terra cotta are within reach of the humblest mechanic, who can raise the means to erect a moderately comfortable cottage. In fact, any man who can now erect a dwelling of wood at a cost of $1,500, can, in the present developments of manufacture, duplicate it in fire proof materials, with no sign of wood in its construction beyond the doors, for an equal or but slightly increased cost, and boast of a dwelling not inferior, and in many respects far superior, to the wooden building, rat and mouse proof, warm, free from dampness, well ventilated, and attractive in appearance.

Should we continue this subject, we should be able to show that the vast amounts of lumber which have heretofore been requisite for sidewalks, railway depot platforms, and various kindred uses, may profitably be superseded by grout, or asphaltum, while iron and glass have been successfully tested as a substitute for wooden rail bearings or ties. In the item of bridge building, iron has to a large extent superseded wood, while the culverts which formerly demanded the consumption of vast quantities of square timber, are on all the main lines of railroad now constructed of stone. In shipbuilding iron has become the favorite material, and the wooden walls of the mercantile and national marine are things of story and song. As a fuel, wood is not a necessity, and the vast coal deposits which a wise Providence has located at convenient points of access are ample to supply all the wants of the world until the trump of eternity shall sound. Cooperage has been no unimportant item in wood consumption, but when we see the petroleum companies abandoning their immense shops, and purchasing a paper barrel to hold this most penetrative and difficult fluid to confine without leakage, we may well assert that wood is no longer an essential in this branch of consumption. It is, in fact, difficult to recall a single branch of manufacture in which wood has hitherto held a most important position where, if necessity demands, its use could not be dispensed with. Still, its loss would be seriously felt in every department, as none of the substitutes hitherto or at present available possess anything like its durability and ease of manipulation.—*N. W. Lumberman.*

APPARATUS FOR MEASURING STRAINS IN STRUCTURES.

THE apparatus represented herewith, which we find figured in the *Annales des Ponts et Chaussees*, is the invention of M. Clevenad, and is designed to measure directly the strains to which the different parts of any structure are submitted. It will operate in any position whatever, and under all possible conditions, multiplying the amount of flexure itself—a result not always obtained in apparatus of this nature. It consists of a metallic wire, *f*, attached at one end to a winged nut, V, which allows of the instrument being adjusted for use. This wire passes over a pulley, *p*, and carries a counterpoise. To keep it from slipping it is held by a small clamp placed in the channel of the pulley. The latter carries an index needle, L, which multiplies the distance traversed by its circumference ten times, and the extremity of which moves across an arc graduated in millimeters. The index needle also moves two slides which show the maximum of elongation or compression. The apparatus and the screw to which the wire is attached are mounted in two different ways, one designed to fasten the whole to a truss rod or to the foot of a T-iron, and the other to attach the apparatus to any ordinary surface. The apparatus having been placed in position, the index having been brought to zero, and the wire being kept at a uniform tension by the weight, it will be seen that if the object to which it is attached elongates or shortens, the pulley will be actuated by the wire, and the lever, L, will multiply the actual amount of the strain exerted. To study maximum strains the two



APPARATUS FOR MEASURING STRAINS.

sliders are moved up against the extremity of the needle. The apparatus may be used on parts of a structure inclined at any angle whatever. The sensitiveness of the apparatus may be known when it is stated that a lighted match placed under the wire will cause the needle to be immediately deflected one, two, and three millimeters.

HOW TO MAKE A TELESCOPE.

By GEORGE M. HOPKINS.

No one can look into the starry depths at night without a feeling of wonder and awe, nor is this feeling lessened when the mind grapples the question of space and contemplates the awful abysm that separates us from even the nearest star, to say nothing of the points of light faintly visible to the naked eye, nor of the telescopic stars removed to such distances as to bewilder the mind and baffle the imagination in the attempt to realize their remoteness.

Who does not desire to become more familiar with these distant bodies and to possess all the knowledge that can be obtained by observation? Much can be done by the unaided eyes, and a great deal more can be accomplished by means of a telescope of very moderate proportions and power. An ordinary opera glass is not to be despised, but of course an instrument with a larger objective and a longer focus is much more efficient and desirable.

It is in deference to the frequently expressed wish of many of the readers of the SCIENTIFIC AMERICAN that I give some hints as to the construction of a cheap and efficient telescope, which will give its possessor a great deal of solid enjoyment, and, it is hoped, create a taste for astronomical research and observation, which will be the means of swelling the ranks of amateur astronomers, and of ultimately advancing astronomical knowledge.

The opposite engraving represents the telescope, its standard, and the various parts, in section and in detail. The object glass, A, shown in the engraving, is a meniscus lens 2½ in. in diameter and 36 to 38 in. focus. It is mounted in a wooden cell, B, having an internal flange or fillet about $\frac{1}{16}$ in. wide, forming a true support for the lens and bearing against the end of the paper tube, D, which forms the body of the telescope. The lens is retained in its cell by a flat strip, E, of brass which is sprung into the cell and pushed down against the lens. The cell is fastened to the tube by common wood screws, which pass through the collar into the paper forming the tube. It is perhaps needless to say that the cell should be made of some thoroughly seasoned hard wood, which is not liable to atmospheric influences. Hard maple answers a good purpose, but mahogany is to be preferred.

To protect the objective when not in use a cap, F, of tin or paste-board neatly covered with morocco or velvet is fitted to the cell.

The paper tube of which the telescope body is formed is such as is commonly used for rolling engravings for mailing. It is 3 inches external diameter and 32 inches long (about 4 inches shorter than the focus of the objective). The exterior of the tube is covered with Java canvas attached by means of bookbinder's paste (flour paste with glue added), and varnished when dry with two or three thin coats of shellac varnish. This gives the tube an elegant and durable finish.

The focusing tube, G, which is of brass, 1¼ inches internal diameter and 12 inches long, is guided by a turned wooden piece, H, fitted to the end of the paste-board tube, D, and held by three or four ordinary round-headed wood screws.

The piece, H, has a shoulder, *a*, against which the end of the paste-board tube abuts, and only about three quarters of an inch of the piece, H, actually fits the tube, the portion from *b* to *c* being tapered as indicated in the engraving, and near the extreme inner end, about 3½ inches from the shoulder, there are three screws, *d*, used in collimating the focusing tube, G.

The bore of the piece, H, is somewhat larger than the focusing tube, G, and is provided with a cloth lining, *e*, at each end to insure the smooth working of the tube.

A short distance from the shoulder, *a*, a mortise about three quarters of an inch square is made through the side of the tube, D, and the piece, H, and a tranverse slot, *f*, is formed to receive the wooden spindle, I, which is enlarged in the middle to receive the rubber thimble, J, and has on one end a milled head by which it may be turned. The spindle, I, is held in place by concave pieces, *g*, which in turn are retained by the curved plate, *k*, attached to the tube, D, by screws. The rubber thimble, J, must be of sufficient diameter to reach to and press upon the focusing tube, and the latter has a series of transverse grooves filed in it. This will insure sufficient friction to move the tube, G, in and out when the spindle, I, is turned. This simple device replaces the usual focusing mechanism, and is to be preferred to a rack and pinion, unless the latter be perfectly made, and it is certainly superior on the score of cheapness.

The cell, B, piece, H, and spindle, I, should be blacked and polished on the outside, and the cell should be left dead black on the inside. The interior of the tubes should also be dead black. This surface may be secured by adding lampblack to a little very thin shellac varnish, and applying it to the inside of the tube by means of a swab. The focal lengths of the lenses of the astronomical eyepiece should be to each other as three to one; the field lens, which is nearest the object glass, having the greatest diameter and the longest focus, and the convex side of each lens should be turned toward the object glass. Their distance apart should be one-half the sum of their focal lengths. These lenses are mounted in a wooden cell, L, whose exterior is fitted to the focusing tube, G, and grooved circumferentially to receive a strip of cloth, which is glued in, and insures a good fit. The cell is bored in different diameters to receive the field lens, *h*, the diaphragm, *i*, and the eye lens, *j*, all of which are held in place against shoulders formed in the cell, by circular springs of brass, which are sprung in, as in the case of the object glass. The eye aperture should be about 1¼ inch, and the aperture of the diaphragm should be about the same.

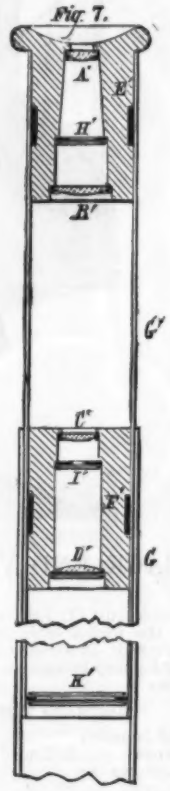
It is well enough to make the diaphragm adjustable, so that it may be moved back and forth to secure the best position. It will be found, however, that, if placed just beyond the focus of the eye lens, it will give the best results.

A circular recess, *k*, is formed in the face of the eyepiece to receive a sun glass, which is retained in place, when in use, by the short-curved spring, *l*. The sun glass is simply a disk of very dark glass. It must, in fact, be nearly opaque; some of the glass, known as black glass, answers the purpose very well.

If but one astronomical eyepiece is made, probably the most satisfactory combination would be: Field lens, 1¼ inches focal length; eye lens, ½ inch; distance apart, 1 inch. It is advisable, however, to have three eyepieces for different purposes—one of higher power and one of lower power than the one described.

In this connection, I will describe a terrestrial eyepiece, referring to the sectional view, Fig. 7, although it is of little

Fig. 7.



TERRESTRIAL EYEPIECE.

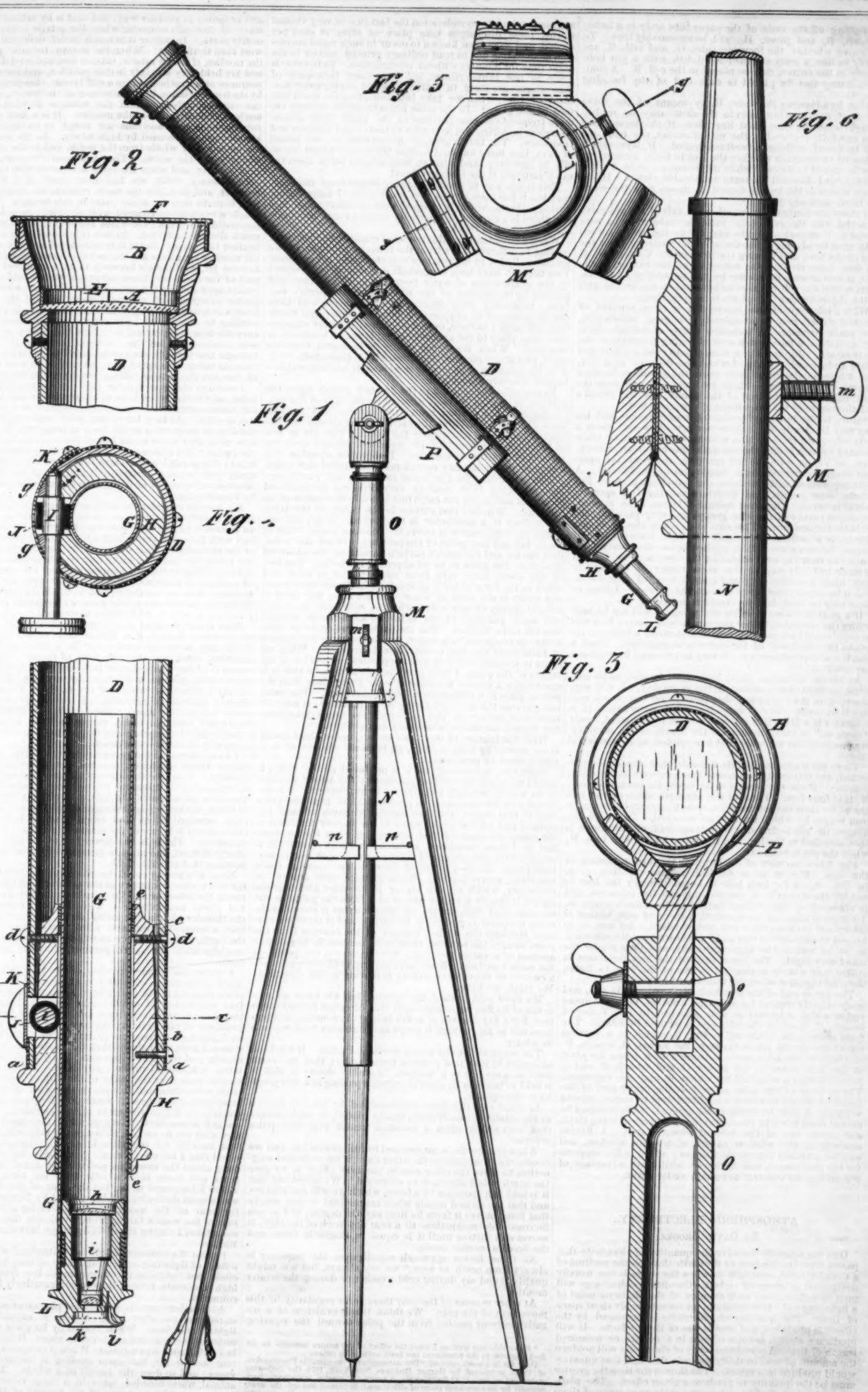
use to adapt such an eyepiece to this instrument unless it is first provided with an achromatic objective. It is then a powerful telescope, which will enable one to see well for many miles. The method of mounting the lenses described in connection with the astronomical eyepieces will be followed here, therefore little more than the diameter and focus of the lenses and their distance apart need be given. There are four plano-convex lenses, A', B', C', D', mounted in two pairs in wooden cells, E', F', fitted to the tube, G', which in turn is fitted to the focusing tube, G. The cell, E', has a ¼ inch aperture for the eye and a bead which projects beyond the tube, G'. The lens, A', is about $\frac{1}{10}$ inch in diameter and 1 inch focus. The lens, B', is ¾ inch diameter and 1½ inch focus. The lens, C', is $\frac{1}{10}$ inch diameter, 1¼ inch focus. The lens, D', is ⅝ diameter and 1¼ inch focus. The plane face of A' is 1¾ inch from the plane face of B', and a stop, H', having a $\frac{1}{10}$ inch aperture, is placed 1¼ inch from the face of the lens, A'. From the plane face of the lens, B', to the plane side of the lens, C', it is 3⅜ inches. The distance between the plane side of the lens, C', and the plane face of the lens, D', is 1⅛ inch. At a distance of $\frac{1}{10}$ inch from the face of the lens, C', there is a diaphragm, I', having a ¼ inch aperture. It will be observed that the convex sides of the lenses, C' D, are turned toward each other.

At the extreme inner end of the tube, G', there is a diaphragm, K', of ⅛ aperture, which is held in place by two circular springs. The interior surfaces must be well blacked to prevent reflection.

I have given cheap, yet efficient methods of holding the lenses. If desired the reader may, of course, make the mountings of brass, and fit the instrument up according to his taste and ability.

The arrangement of the various parts is clearly shown in the sectional view, Fig. 2, and the focusing device is shown in Fig. 4, which is a transverse section taken on line, *x x*, in Fig. 2.

In regard to the matter of collimation I have found that



HOW TO MAKE A TELESCOPE.—By GEO. M. HOPKINS.

by cutting off the ends of the paper tube truly in a lathe, the cell, B, and piece, H, will be measurably true. To determine whether the focusing tube, G, and cell, B, are axially in line, a truly cut card-board disk with a pin hole exactly in the center, may be placed in the cell, B. A similar disk may also be placed in each end of the focusing tube, G.

Now, by adjusting the piece, H, by means of the three screws, *d*, the three pin holes in the disks may be readily brought upon the same axial line; then, if the lenses have been carefully centered by the manufacturer, the telescope will be found sufficiently well collimated. If, however, it is desired to ascertain whether the lens is truly centered, it may be turned in its cell, while the telescope is in a fixed position, and directed at some immovable object. If the image moves as the lens is turned, it shows that the work has been carelessly done.

If there are doubts as to whether the axis of the objective coincides with the axis of the tube, the tube may be supported in V-shaped supports adapted to the truly turned ends, then by placing a candle at some distance from the face of the lens, and turning the tube in its V supports, at the same time viewing the reflection of the candle in the lens, it will at once be known by the movement of the reflection that the cell requires adjustment to render the axis of the objective and that of the tube coincident.

With a telescope of this description a large number of celestial objects may be examined with great satisfaction. The moon furnishes an unending source of delight, showing, as it does, a face that is ever changing throughout the lunar month. Jupiter is now coming into good position and afford an interesting study of which one does not soon tire. The telescope described will show the satellites in their varying positions from night to night. It will show the dark band across the face of the planet, and will afford a realizing sense of the magnitude of this great body.

Saturn is also in a good position for observation, and his ring may be clearly seen. The meniscus lens will show a little color, and its definition will be quite defective when directed to such bright objects as the moon, Jupiter, Saturn, Mars, or Venus, with the full aperture, therefore the aperture should be reduced by a diaphragm of card-board. A little experiment will determine the best sized aperture. For nebulæ, star groups, and double stars, the full aperture should be used. The great nebula of Orion is an interesting object; many of the star groups are very pleasing, the Pleiades for instance. The sun also, when the spots are visible, is a satisfactory object for this instrument. Of course, the sun glass will be applied before the observer attempts to view the sun, otherwise the eye may be injured or destroyed. It may be that some reader of this article may have a double or plano-convex lens, of long focus, which he might desire to press into the service. Either of these may be used, but the meniscus is better.

If a good job is made of the mountings it will not be long before the meniscus, or the plano or double convex lens will be supplanted by a good achromatic objective, which will increase the efficiency of the instrument manyfold. Such a lens is not very expensive. It may be procured from almost any optician.

As to the telescope stand little need be said, as its construction is so clearly shown in the engraving. I will say, however, in the beginning, that there is no danger of getting it too solid. If it is very clumsy it is no matter. If it is slender it will be like a "reed shaken by the wind," only "more so," as every tremor has the benefit of the magnifying power of the telescope and is amplified to a wonderful extent.

There are undoubtedly better stands than the one represented, but it is easily constructed and answers an excellent purpose. From the ground to the top of the hexagonal hub, M, it is four feet. Three of the alternate sides of the hub are wider than the intermediate ones, to receive the wrought iron hinges by which the legs are attached. To attach the hinges, the pin is first driven out; one-half of the hinge is then attached to the leg, and the other half to the hub, M, when the pin is replaced.

Fig. 5 is a top view of the hub and the upper portion of the legs. Fig. 6 is a vertical section on line, *y*, *y*, in Fig. 5. A 1¼ inch hole is bored through the hub to receive the standard, N, which supports the telescope and is clamped at any desired height by the thumb screw, *m*. To prevent marring the standard a piece of sole leather is interposed between the screw and standard. An arm, *n*, is hinged to each of the legs and folds down upon the standard, so as to spring the legs outwardly, and thus render the stand very rigid. The lower ends of the legs terminate in spikes, and a strap is attached to one of the legs to fasten them all together when the instrument is not in use.

The upper end of the standard. N, is reduced in size, and made slightly conical for receiving a socket, O, to the upper end of which is jointed an arm attached to the V-shaped trough, P, in which the telescope is secured by straps. The form of the joint is shown in Fig. 3, which is a vertical transverse section taken through the socket, O, trough, P, and body of the telescope. A strong bolt, *o*, forms the pivot of the joint between the socket, O, and trough, P, and is provided with a wing nut by which it may be tightened. The surfaces of the joint as well as the upper end of the standard should be crated with black lead to insure smooth working. A post set firmly in the ground, while it cannot be moved from place to place, has the advantage of being rigid, and forms one of the best of cheap stands. A fixture screwed in the window casing of a south window, and another attached to a north window, afford solid supports for the instrument, and have the additional advantage of permitting the observer to remain under cover.

ATMOSPHERIC ELECTRICITY.

By DAVID BROOKS.

ONE can scarcely conceive the quantity of electricity that passes from the heavens to the earth through the medium of a thunderstorm, especially so when the storm is one usually designated as severe or violent. One flash or discharge will melt or deflagrate an inch or more of the platinum point of a lightning rod. It does this in an inconceivably short space of time. The quantity of electricity is measured by the effects it produces, and heat is one of those effects. It will produce a certain amount of heat in a certain or measured length of time. A certain quantity of electricity will produce the amount of heat in thirty seconds that half that quantity would produce in a minute. The shorter the time the greater must be the quantity to produce a given effect. The platinum point is melted in an immeasurably short space of time; then immeasurably great is the quantity required to produce this effect. I have spoken of one atmospheric discharge, and must take into consideration the fact that in very violent storms these discharges take place as often as once per second, and have been known to occur in such rapid succession as to enable one to read ordinary printed matter in the night time for minutes without intermission. Reference is made to one thunderstorm, but how many thousands of these storms are there in active progress during every moment of time, when we take into consideration the whole face of the globe? In the same latitude thunderstorms are more frequent on some portions of the earth than others. Travelers in Africa and Asia refer to their great violence and frequency. The Dutch give, as the statistics of the island of Java, that three hundred human beings are killed annually by lightning; and what an insignificant patch upon the earth's surface is the island of Java!

This is one way in which lightning comes from the heavens; but it has been proven that every drop of water falling during a thunderstorm is charged with electricity, and also that there is a current of electricity coming from the heavens at all times in this latitude.

When we contemplate this immense quantity of electricity coming in different ways from the heavens to the earth, we are naturally led to inquire how this electricity is generated. Two theories have been suggested: one that it is produced by the evaporation of water from the earth's surface, and another by the friction of the winds upon the earth's surface. Reasoning from analogy or experiment, very little can be produced by evaporation, because, under that condition, the earth's surface, or that portion of it where evaporation takes place to the greatest extent, is not an insulator, or insulated. When the steam boiler is insulated from the earth, and steam escapes, then electricity is generated; otherwise the quantity of electricity generated is not observable—indeed, scarcely appreciable.

Evaporation is produced to the greatest extent upon the surface of the earth most affected by the rays of the sun, consequently the portion nearer the equator and farthest from the poles. Neither the earth nor the air can be considered insulators, particularly the earth. The air is less an insulator on account of its warm temperature and the amount of moisture it contains. I therefore abandon this theory as producing any considerable amount of electricity.

Now, regarding the friction of the air on the earth's surface, reasoning from analogy, very little can be produced upon that surface of the earth that is not in the nature of an insulator. Whether that surface is the ocean or the land, the surface is a conductor in this latitude, or any latitude where the temperature is above the freezing point. But if we go beyond that point of temperature, toward the poles, then the air and the earth's surface partake of the nature of insulators, the more so as we approach the poles. The ices of the ocean have very little saline matter in them, and water in the form of ice is an insulator in the ordinary sense, and water in the form of snow and ice upon the land is formed simply of rain water, which is still more pure, and still more partakes of the nature of an insulator, with all that the term implies. The insulating properties of rain water, or congealed rain water, double for every ten degrees of Fahrenheit that the temperature is reduced. When we come to consider the very low temperature of the ice in the region of the poles, I have every reason to believe that it is specifically a greater insulator at —50° Fahrenheit than the purest glass in a temperature +50° Fahrenheit. The same law governs the air in its nature as an insulator; it must be immensely higher in that extremely low temperature than any known substance in ordinary temperature.

With the friction of those two bodies, under these conditions, reasoning from analogy, an immense amount of electricity must be produced.

Therefore, presuming that it is produced at the poles, it would naturally rise and accumulate in the upper stratum of air which, becomes a conductor by rarefaction. It is believed that the electricity so produced at or near the poles rises to that region, and then travels or moves toward the equator and returns to the earth in the manner described at the commencement of this article, and when the air, rarefied as before mentioned, is surcharged with electricity, it produces the phenomena of aurora borealis and aurora australis; that the two poles of the earth are immense Holtz machines, generating this almost inconceivable amount of electricity, which we are trying to consider, and that the aurora is simply a visible stream of it from the poles to the equator; that this stream of electricity as it comes to the earth, certainly is positive in its nature, and if there is a current through the higher regions of the heavens from the poles toward the equator, there must necessarily be an equal amount of negative electricity flowing toward the poles on the earth's surface. Now, have we any evidence that such a current of negative electricity is flowing in that direction? We think we have.

We have said toward the equator, but we have no evidence of its flowing or moving in that direction farther south than forty five degrees of north latitude in summer, and perhaps not so far, though it keeps that direction farther south in winter.

The magnetic needle points north and south. It has been supposed to take that position from the fact that the earth itself acts upon it as a magnet. Another theory is, that it is held in position by electric currents passing in a line parallel to the equator.

In either case this force is neutralized by what is known as the astatic needle system; that is, placing in such manner that they swing upon a common center with their poles reversed.

When one needle is magnetized to full saturation, and we commence to magnetize the other until it has sufficient magnetism to move the other needle, the first effect is to give the north pole a direction to westward. We might say that it is held in its position by a force, which we will call ten (10), and that the second needle when magnetized to very nearly that force moves it from its line, say one degree; and as you increase this magnetism to a near approach of equality, it moves still further until it is equal in magnetic force, and the needles become astatic.

As these forces approach equalization, the tendency is always from north to west;* we say always, but we might qualify it and say during cold weather or during the winter months.

At other seasons of the year there is no regularity to this movement of the pair. We think this is evidence of a negative current passing from the poles toward the equator, and is shown in another way, and that is by taking the constant of the galvanometer when the astatic system points nearly north. In winter it is much easier deflected to the west than to the east. When the aurora borealis prevails, the needles, if nearly astatic, take an east and west direction, and are held very strongly in that position, and have the appearance of a weather vane in a stiff breeze, changing quickly by the least variation in the direction of the breeze, although the current, different from the wind, is flowing in right angles to the direction of the needles. It is a fact that aurora borealis and australis are noted by navigators to be almost always preceded by high winds. In the north they are preceded by winds from the north, and in the south by winds from the south. They are most frequent, also, in cold weather, and when the earth is covered with snow.

In January, 1852, we had deep snow and very cold weather, and probably the most remarkable display of aurora borealis seen for many years in this latitude. The telegraph wires were so charged with electricity as to be almost impossible to work; the wires running east and west were much the most affected. At first this would seem to operate against this theory; but if it is considered that the earth and the rarefied air above are the two conductors of an immense Leyden jar, and the air between these conductors acts the part of the dielectric, these telegraph wires would simply be points approaching the outer conductor, upon which would gather electricity of greater density; and if the currents from north to south simply take the earth or the wires according to the law of least resistance, as ordinary electric currents flow, they would not show themselves upon these wire conductors; but the currents traveling through the heavens and through the earth move like currents through vacuum tubes, at a speed sluggish compared with the speed of currents through metallic or ordinary conductors.

Assuming that atmospheric electricity is generated at the poles, and flows in the lines of longitude toward the equator, these currents must necessarily expand and become of less density. As they leave the polar regions they are expanding in proportion as the lines of longitude diverge, and flow until they come to the belt of the earth on both sides of the equator and embracing each of the temperate zones, and it is in this portion of the earth that these electricities unite again and become neutralized; and one of the visible and demonstrative modes of doing so is through the part played by thunderstorms.

We have to consider the earth and the stratum of rarefied air surrounding the earth as the two conducting plates of an immense Leyden jar, and that portion of the air in contact with the earth and between the two as playing the part of the dielectric. This dielectric, in the neighborhood of the poles, has immense insulating or non-conducting properties, owing to the low temperature and the small amount of moisture it contains. But as it approaches the equator it becomes less an insulator, and is the leaky portion of the dielectric, on account of the greater amount of moisture it contains, as well as its higher temperature.

Now comes the part played by thunderstorms. When the air becomes heated it, is lighter from expansion, rises upward, and, becoming cooled by the greater elevation, the moisture condenses into the form of vapor. This body of vapor is of itself a conductor in which the electricity of the upper strata gathers, and when surcharged breaks through the air between the vapor and the earth in disruptive discharges known as lightning. If the vapor extends to a great height the more rapid is this concentration of the electricity, and the cloud simply becomes a point of the outer conductor approaching nearest to the earth, and consequently of the greatest density.

I have compared the two poles of the earth to two immense Holtz machines, generating the electricity of the heavens. Now, the thunder clouds and the earth beneath are the points of discharge where these electricities unite. Very few are aware of the height to which a thunder cloud extends; the lower edge averages about two miles, the upper edge between fifteen and twenty-five. I have measured them often; it is one of the simplest problems in plain trigonometry. There is the lower line of the clouds which is clearly defined, and must be separated from the falling drops between that and the earth.

Now, if a person could be placed at the North Pole, and the earth were cut in two at the equator, and the portion between the observer and the equator removed, and this rarefied circle made visible as a conductor in connection with the thunder clouds, the outer circle, or conductor, would have a serrated appearance, with points converging toward the earth. We have here an exact similitude of an electric machine with the spark passing from the clouds to the earth.

I spent the greater portion of the year 1851 in Mexico, much of the time along the line of the Cordilleras, and have often thought of the part played by mountains that extend into the region of rarefied air. During the rainy season they have storms about these mountains that have every appearance of the ordinary thunderstorm except that there is no lightning—tremendous storm, but no lightning—and the reason I assign for this is that the mountains penetrate the clouds, and the electricities combine by means of the mountains, without disruptive discharge. Almost every day clouds pass over the valley of the City of Mexico, which is itself seven thousand feet above the level of the sea. Atmospheric discharges are much less frequent than in this country, or where the earth is less elevated. Never did I see any atmospheric discharge when the cloud was in contact with the mountain, although the rain from these clouds was heavier for the time being than that of any thunder cloud that I have ever seen. Sometimes the clouds would hang about the mountain and the rain come down in torrents not more than a mile from me, not a drop falling where I happened to be; but the roar of the falling water was almost deafening. I have stood by Niagara Falls, and the roar of the waters there has been far exceeded by the roar of the waters falling from the clouds that skirted the mountains forming the dividing ridge between Pueblo and Mexico.

I spent the summer of 1873 in Switzerland without seeing a flash of lightning or hearing a clap of thunder, and I conclude that lightning is certainly much less frequent among high mountain ranges than in comparatively low and level countries.

A thunderstorm is a curious phenomenon. As before stated, the air, after being heated, is expanded, becomes lighter, and rises. When cooled by its great elevation, the moisture is condensed and becomes vapor. It has its similitude in a puff from a steam boiler. When it escapes it is as transparent as the air, but upon cooling it becomes a cloud of vapor; and so does the breath of a whale. This immense animal, warm-blooded, takes in a large volume of air into his lungs, which partakes of the warmth of the body. He rises to the surface and blows it upward, and in cold lati-

* Since this was written I learn the effect of the aurora borealis to deflect a needle to the northwest has been noticed by others.

Page 448 in a work entitled "The Atmosphere," by Camille Flammarion, of Paris, published by Harper Brothers, New York, 1874, the following statement occurs: "At Spitzbergen, a magnetic needle suspended horizontally by an untwisted piece of silk thread, is turned toward the west; as soon as the aurora begins, the person observing this needle remarks that, instead of being sensibly motionless, it is agitated, passing to and fro from right to left and from left to right."

tudes it has the appearance of the escape of steam from an engine, on account of the sudden condensation by cooling. The same phenomenon is observable from the breath of a horse in cold weather.

I have spoken of the evidence of negative electricity passing from the poles to the equator by the behavior of a pair of needles; as they become astatic, the north pole tending westward, it is obvious that the needles in latitudes nearer the south pole, under the same conditions, would have a contrary tendency; that is, currents passing from the south pole toward the equator would influence the north poles of those needles toward the east, or should do so to prove this theory correct. The author has never had any opportunity of similar observations in southern latitudes.

If an observer could be placed high above the earth, in a position to view a thunder-cloud, and the electric currents could be made visible to the eye, he would see these currents flowing in all directions toward the thunder-cloud.

Again, if he had in view that belt of earth, the torrid and the two temperate zones, he would find it pitted with thunderstorms; and these are simply points where the positive electricity generated at the poles is discharged to the earth.

I have referred to thunderstorms; but there is another phenomenon not coming under that head, known as waterspouts or whirlwinds. It is generally supposed that these gyratory currents are produced by the action of two currents of air flowing side by side in opposite directions. I believe a better explanation is given by the motion of a liquid poured into a funnel. The air when heated breaks through another stratum of air above, and becoming lighter from expansion, rushes upward with great force, and, to use a paradoxical expression, the air gravitates upward in the same manner and with the same gyratory motion as the fluid in the funnel.

Elderly people are familiar with a picture of the maelstrom. My first geography had a picture of a ship being ingulfed and carried down in this whirlpool of waters somewhere off the coast of Norway; this picture represented a ship going down stern foremost, and the sailor had climbed on the bowsprit, trying to economize the last moment of his life. At this date many doubt that the maelstrom ever existed, and think ancient navigators imposed upon our credulity. I am inclined to take a more charitable view of the case, and believe the hole has long since filled up—that is my explanation of the maelstrom.

Intimately connected with this subject is the lightning rod, concerning which I have written before. Franklin announced that atmospheric electricity was identical with frictional electricity. I think he made a mistake—a very slight one, however—in using the word "identical," but should have said it *was* frictional electricity generated at the poles of the earth, as I have endeavored to explain. The idea of the lightning rod is to provide a better conductor than the object we wish to protect, and a harmless path for the fluid from the heavens to the earth.

But at this date it is sometimes most absurdly applied. Five years ago I happened to cross the Atlantic on the steamer Vaderland, an iron vessel with iron masts and iron stays. Some electrical genius had supplied these masts with lightning rods made of about No. 4 copper wire. They ran from the top of the mast down by the side of the ship and terminated in the water. Now, the idea of providing a better conductor for the fluid than the masts of the ship and its iron stays by substituting this copper wire seemed to me rather absurd. I was then on my way to the Vienna Exposition, and this most absurd provision against the effects of lightning often revolved in my mind. No doubt the person who put up those rods had often congratulated himself that he has saved the Vaderland many times from destruction; but I afterwards found that this quintessence of absurdity more than had its parallel. I ascended the dome of the great iron building at Vienna, the largest building of modern times, and I found that equipped from the top to the bottom with a rod of about a quarter of an inch square. This rod was well mounted with barbed points, and carefully insulated in glass thimbles to keep the current from flying from the rod to the building. Now, as the attraction of these metals is in proportion to the bulk or mass, the idea that the lightning should take this rod in preference to the building itself was an absurdity rather more extravagant than that exhibited in the case of the rods on the steamer Vaderland.

A lightning rod, to be effective, should be a better conductor of electricity than the objects it proposes to protect. In most cases it is; but in the case of the steamer Vaderland its attraction, in proportion to that of the ship, was less than one to a million, and the chances of its ever becoming the path of an electric discharge are even more remote. In case the lightning struck the masts of the Vaderland or the Exposition building at Vienna, no harm could follow. But rods are erected upon equally absurd principles to protect oil tanks. These immense iron vessels, containing thousands of barrels of oil, are in great danger of destruction.

Concerning these oil tanks, reference was made in an article of mine on lightning rods, published seven years since by the Franklin Institute, from which I quote as follows:

"Oil tanks are usually well connected to the earth—that is electrically—by pipes running to the distilleries, and for the purposes of filling and discharging these tanks, the connecting pipes being buried in the ground. There have been explosions and fires involving great loss connected with the manufacture and storage of petroleum, supposed to have originated by being struck by lightning. Do the lightning rods we see placed so numerously about these tanks have any effect to prevent these catastrophes? In my opinion, not the least.

"These tanks are immense air-tight vessels, with the upper portion in the form of a dome. The lighter portions of these oils rise to the top of the dome. These lighter and more volatile oils are very inflammable, and when mixed with air are as explosive as gunpowder. The iron tank, being electrically well connected to the earth, is a conductor exercising great attraction for the electricity of the clouds, and should a discharge from the cloud take place, the stroke would center upon that portion of the dome most elevated, and directly upon the plate of iron in contact with the explosive compound. The iron becomes instantly melted or intensely heated, causing an explosion of the vessel, followed, most probably, by a frightful conflagration. This tank, which would, upon first sight, seem to be of a material most safe to protect the contents from fire or accident of this nature, is, upon reflection, exceedingly defective, and in imminent peril during times of thunderstorms.

"An iron rod, fastened to the side or bottom of the tank, and made to extend, say twenty or thirty feet above the dome, would be a part of the tank as a conductor. The point of the rod would be the point to receive the discharge. The lightning might melt an inch or so of the projecting point of the rod, but would not raise the temperature of any portion of the tank proper, or that in contact with the explosive or inflammable contents. Oil tanks could in this manner be safely protected from the effects of lightning."

At the time this article was published the president of one of the largest oil companies sent the article to the superintendent in the oil regions. The superintendent answered the president that he "had read the article, and he did not by any means agree with its author. He had all his tanks surrounded with rods, and although they had at times been under sheet lightning—the most destructive kind—they had served as a perfect protection."

A little later the company called on one of the insurance offices and recovered $60,000 damages from lightning. Whether the superintendent's views have been modified or not I have not taken the trouble to learn; nor have I been able to learn which he now considers the most destructive, sheet lightning or chain lightning, or some other variety.

In the article before referred to I endeavored to show the great difficulty in making a proper connection of the rod with the earth. To be electrically perfect, it should be of immense size or surface. It is simply the joining of two conductors whose specific conductive capacities differ in immense degree.

To illustrate this, I endeavored to show that to join a copper wire with an iron wire of equal conductive capacity, and seven times as large as the copper wire, as it must necessarily be, the end of the copper wire must be enlarged to the full size, or diameter and section, of the iron wire, in order that the joint should have the full conducting capacity of the copper wire. Now, in making a joint with the earth, the end of the lightning rod must be enlarged in as great proportion as the earth's specific conducting capacity is less.

Dr. Matthiessen gives the ratio of the conducting properties of iron to that with sulphuric acid and water, in the proportion of one of water to eleven of acid—the best conducting liquid known—as 1:6,000 to 1. My own researches would make ordinary spring or river water's conducting proportion to this acid solution at best in the proportion of about 1 to 500.

Now, we will suppose that the rod has a section of one-half square inch, and that it terminates in water. The ground-plate, in order to expose a surface to make the joint of equal conducting capacity to a section of the rod, must be two hundred and seventy feet square, allowing that it conducted from both sides; but, in case it was laid horizontally or parallel to the earth's surface, it must, in order to bring the upper surface of the plate into equal conducting lines with the under surface, be placed sixty feet below the surface of the water. Now, as the earth conducts only in proportion as it contains water, this plate must be enlarged still further to make up for the proportion of earth contained in this water. I will draw upon the imagination of the reader to fill the balance, in order to get the ground-plate to the requisite size and depth to which it would have to be buried.

Nine hundred and ninety-nine out of a thousand of the defects in lightning rods are due to this one thing.

For the last twenty years scarcely a week has passed without a number of patents for improvements in lightning rods. The effect of granting these patents, without a single exception, is pernicious, because they enable the patentee to make the public trust in the rods when they are deficient in the most essential requisite—complete connection with the earth.

Considering the amount expended on lightning rods, and the great source of danger they are instead of protection, it would be a mercy to the community if the Government would take the matter in hand, and appoint a commission to go through the country and take down those that cannot be made effective.

I have been a very attentive observer of the effects of lightning upon buildings in this city for the last thirty years, and have never yet known the occupants injured where gas or water pipes were used. The buildings were often set on fire by the lightning flying from the rods to the gas pipes or from metallic roofs to the gas pipes. A person standing upon a metallic roof would be in great danger from this cause; but if the person be in the first or second story, or in any portion of the building that is below the gas or water pipes, he would be perfectly safe, unless there happened to be a defective lightning rod attached to the building, and this person happened to be between the rod and the pipes at a point where they approached nearest each other.

Gas and water pipes are the best lightning rods ever erected, because they are, electrically, in perfect connection with the earth.

They should extend to the very top of the building, or be connected by a rod running to that elevation. A lightning rod terminating on a railway track is also perfectly safe; but a rod that is not connected with gas or water pipes or a railway track is defective, unless the terminal is of such size and depth as would make it enormously expensive.

And those who do not believe in this assertion are respectfully referred to the amount of property destroyed annually, in the shape of buildings that have lightning rods attached of the latest and most improved patents.

When the discharge is partially obscured from the observer by a cloud, and so far that the report is not audible, it is often called sheet lightning. We can, with equal propriety, call the light, partially obscured by ground glass or by fog, "sheet light."

HEAT LIGHTNING.—In the night-time the flashes of lightning can be seen in the sky, apparently coming directly from the earth or horizon. The thunder-cloud, often hundreds of miles distant, is hid entirely from the observer by the convex surface of the earth. The distance to which the light flashes into the heavens is proof that the atmosphere extends much higher than is generally supposed.—*Journal of the Telegraph.*

A FLORIDA TYPHOON.

FLORIDA summers are passably cool. The thermometer rests between 80° and 90°, with occasional spurts to 100°. At night the heat is frequently intense. Without a close sand-fly bar there is no rest, and with one no air. Grateful dews cool the air before daylight, but a coppery sun soon reappears, and up to 9 A.M. the atmosphere is like that of a furnace. Then a refreshing trade wind sets in from the southeast, and blows steadily until sundown. This trade wind lasts three months, say from the middle of June to about the same time in September. Without it, life on the eastern coast would be insupportable. There are days in which the air becomes mucky and sticky. A dead land breeze covers the earth. Sands and marshes throw out a tremulous heat, blinding to the eye; the leaves of the oleanders and fig trees shrink under the burning rays of the sun; the sky seems roofed by a brazen dome, and gardens and groves fairly pant for breath.

On the approach of autumn the Floridian quakes with apprehension. It is the dread season of hurricanes. Tearing through the West Indies, they often strike the coast with deadly effect. With scarcely a note of warning, houses are overthrown, sailboats blown from the water, and orange groves swept bare of leaves and fruit. Some of the old settlers say they can detect signs of the storm a day before it breaks upon them.

"You feel it in the air before it comes," says one. This is, however, an indefinite sign. The devastation lining its track certainly proves that "you feel it in the air after it comes." One of these typhoons visits the coast every year. The day may be bright and beautiful, and the flowers heavy with bees and humming birds. Shimmering mosquito hawks quiver in the air, and the scarlet cardinal twitters in the acacias. A cooling breeze plays through the leaves of the trees and gently swings the unripe oranges. Clouds of gulls soar above the dark green mangrove bushes, and the sand bars, at low tide, are covered with pensive curlews and willets. The drowsy roar of the surf is heard, and the gentle swell of the ocean is rippled with golden sheen.

Almost imperceptibly the wind dies away. Cries of terns and water birds fall upon the ear with painful distinctness. The mud hens of the marshes pipe an alarm. Not a blade of salt grass moves. The blue sky grows hazy and the eastern horizon is milky white. Fitful gusts begin to ripple the water and handle the green leaves. A low moan comes from the ocean. Smoky clouds roll into the sky from the southeast, and a strong wind whitens the ruffled water. Every minute it increases in fury. An ominous yellow light tinges the atmosphere. The sun is gone, and great drops of rain are hurled to the ground. Within fifteen minutes there is a gale, and soon the full force of the hurricane is felt. Great eagles and pelicans are swept through the heavens utterly powerless. Sparrows and other small birds are lashed to death by leafless twigs and the torn bodies of snowy herons and wild turkeys lodge in the branches of the live oak and cypress tree.

All living things disappear. Tall pines are twisted asunder. The lithe limbs of willows and oleanders snap like cow whips. Lofty palmettoes bend their heads to the ground, their great fans turned inside out like the ribs of an umbrella. The force of the wind keeps the trees down until every green fan pops like a pistol shot. Orange groves are ripped into shoe strings. The leaves of the scraggy scrub on the beach are wiped out, and their stems whipped into little brushes. The tough saw palmetto is blown as flat as a northern wheatfield, and the dead grass of the savannas lashed into fine dust. Boards in the surf are struck by the wind, and sent spinning hundreds of feet into the air. The sand dunes are caught up bodily and sifted through the tops of pine trees miles away. The foam of the sea is blown beneath the houses on the mainland, and comes up between the cracks of the floor like steam.

Woe to the owners of sail boats and boat houses. At Lake Worth the Cruiser, a heavy round bottomed sail boat, thirty-two feet long, owned by Captain Charles Moore, was picked up from her ways, rigging and all, and carried across the lake, a mile away, without touching the water. A boat owned by Dr. Wallace, of Castle Windy, was torn from her moorings, lifted from the water, and dropped into a salt water marsh fringing Mosquito Lagoon, eight hundred yards from the castle. In the fall of 1876 the Ida Smith, a large schooner running between New Smyrna and Jacksonville, was torn from her anchors and stranded on a marsh five hundred yards from the ship channel. The coast survey steamer, in a good harbor, sheltered by sand banks, threw out three anchors and kept her wheels working against the wind under a full head of steam. She dragged her anchors several hundred yards and barely escaped destruction.

These hurricanes last from seven to eight hours, even longer. During the lull rain falls in torrents. The tide rises to a great height, carrying away wharves and boat houses and flooding the country for miles. The ocean leaps the sandy barriers of the coast, and floods the Indian and other salt water rivers, involving great damage. After the storm, center boards and jib stays are found in spruce pines, oleanders are loaded with cordage, and dead eyes and peak blocks drop from leafless orange trees. Gardens are destroyed, fences swept away, and the tormented Floridian has three months' work and no pay to repair damages.

Vessels are driven ashore and sometimes many lives lost. The Ladona, a New York steamship, went ashore twelve miles north of Canaveral in the great gale of August 23, 1871. All on board perished. Since then many vessels have been wrecked.—*Ziska, in River Record.*

CONSTANT BATH TREATMENT OF FEVER.

ACCORDING to the *Lancet*, Dr. Reiss, of Berlin, has proposed the employment of the bath in the treatment of typhoid and other febrile diseases in a somewhat novel form. The antipyretic effect of brief and powerful refrigeration is often transient, and at the height of the disease hourly or half-hourly baths have to be employed. It is proposed, therefore, to employ a continuous but slightly refrigerating agent—namely, to keep the patient constantly in a bath of lukewarm water. A temperature of 88° has been found the most convenient. The use of such baths obviously prevents considerable practical difficulties, which are, however, not insurmountable. The patient should lie in a sheet, suspended hammock like within the bath, and when the first inconveniences are over the patient enjoys it, and can be kept in it for a whole day or several days. Dr. Reiss has tried the method in forty-eight cases of typhoid (besides one incompletely treated case). It was used only in pronounced cases, for the most part in the early stage, the bath being commenced at from the third to the twelfth day. The temperature was taken every one or two hours, in either the rectum or axilla. As a rule, the bath was continued without intermission for the first twenty-four hours, unless the fall of the temperature was too great. After the second day the rule was followed to take the patient from the bath whenever the rectal temperature was below 99·2°, and to reimmerse whenever the temperature rose above 101·5° F. The results are said to be strikingly good. With the exception of some very obstinate cases, the temperature fell quickly in the bath so as to reach the normal in from twelve to twenty-four hours. On removal, the temperature rose rapidly in the earlier stages of the disease, more slowly in the later periods, so that the intervals between successive baths were at first short and afterward gradually lengthened. In obstinate cases, in which the bath at 88° F. did not reduce the temperature below 102°, transient cooler baths were employed to keep the temperature down.

In forty-two cases available for comparison, the duration of the bath treatment varied between 7 and 38 days, and was, on an average, 18·3 days. Of the forty-eight cases, three died, giving a mortality of 6·2 per cent. In two of these there was pneumonia. The latter fact seems to suggest that this method is not free from the danger of occasionally doing harm—but the influence of the bath on the other symptoms of the disease is said to have been not unfavorable. The pulse remains frequent, contrasting with the depressed temperature, but it often improves in quality. The most favorable effect is produced upon the cerebral symptoms, somnolence or delirium rapidly ceasing. Any severe pulmonary or intestinal symptoms were absent in most of the cases.

We may add, that Dr. Austin Flint, of this city, in a recent clinical lecture, published in the *Medical Times*, recommends the constant bath treatment for typhoid fever. The method which he suggests is the sponge bath.

THE CURE OF CONSTITUTIONAL DISEASES BY THE USE OF GLASSES.*

GENTLEMEN: One of the first lessons a medical man has to learn is not only what he can do, but also what he cannot do. When a physician has acquired the wisdom which will enable him to do nothing when he should do nothing, he is far on the road to knowledge. The tendency among most young practitioners, so far as I know, is to do too much. When an ophthalmic case falls into his hands, unless there has been thorough discipline in a long hospital course, the young practitioner is very apt to put on a shade, a pair of glasses, a blister, a bandage, confine the patient in a dark room, apply nitrate of silver, lower the diet, and so forth. This kind of mistaken practice does much harm, and, therefore, a great deal of my instruction is an attempt to prevent you from doing too much.

When Donders explained to the profession the great advantage which a large number of people, heretofore without relief for their eyes, could obtain by the use of glasses, he accomplished something for medical science which cannot be overestimated; and to go much farther back than Donders to the time when an Italian adapted the magnifying power of glass to assist the sight of aged people, we can say that this unknown man did that which made him worthy of a monument and a grateful remembrance. The same may be said of him who suggested giving concave glasses to myopes. That man did a great service to the world. If Gustavus Adolphus had had concave glasses, I think he would have not only won the battle of Lutzen, but also saved his own life; but, as he did not have them, he was unable to distinguish his own colors, and became entangled among the Austrians and was killed. His inability to see objects at a distance—and in those days there was no artificial aid to vision—led him to suppose that the enemy were his own men, and the life of a great general was sacrificed.

These three suggestions: that by Donders—glasses for hypermetropia and astigmatism, that of the use of concave glasses for myopic persons, and then that of the Italian of convex glasses for old people, were great deeds, and no words of mine can adequately express their value to the human race. But when, from these great discoveries, we go to the extreme of thinking that glasses can cure general affections, such as chorea and epilepsy, then you may be sure that the wave of medical opinion has gone too far, and that the time for its return has come.

I am led to this kind of an introduction to the subject of the lecture to-day—the cure of constitutional disease by the aid of glasses—by the fact that it is claimed, by one writer at least, that by the aid of prisms and convex glasses very great results may be obtained in the relief of such diseases as chorea, epilepsy, and hystero-epilepsy.

It is claimed that many reflex nervous phenomena are caused by disproportionate power between the external muscles of the eye and the ciliary muscle. I believe in certain reflex nervous phenomena as affecting the nutrition of the eye and vision. I believe, for instance, that if a man or woman or child needs spectacles and does not wear them, he or she is very apt to have inflammation of the edges of the lids, which is very intractable unless the error of refraction, the trouble for which the glasses should be worn, is corrected by the use of glasses. *But* I do not believe that all cases of blepharitis are caused by failure to wear glasses. I believe that a great many cases are influenced unfavorably, and that some are *caused* by this trouble. When, however, the theory was advanced that chorea was entirely a reflex phenomenon, I was startled. When the theory was advanced that hypermetropia—especially if complicated by astigmatism, a condition in which there is a congenital shortening of the antero-posterior diameter of the eyeball—if uncorrected, was the cause of a great deal of chorea, and that it could be cured by the aid of convex glasses, I was, I say, startled, and I proceeded with my fellow-practitioners at once to investigate the entire subject. What did we find as the result of that investigation? We found, in the first place, that chorea existed before any one knew sufficient to prescribe glasses to correct hypermetropia; and we found also that it was recovered from before anybody knew that glasses were prescribed for the correction of hypermetropia and astigmatism. Furthermore, we found that quite a proportion of children were born hypermetropic, and yet never had suffered from chorea. We found also that quite a proportion who had chorea did not have hypermetropia. With such facts I think the bottom went out of that theory—for these facts are all upon record—as thoroughly as it ever went out of any tub that was completely demolished. All there was left of this new theory was this, namely—in the treatment of any disease everything which you can do to put the patient in a normal condition, as regards seeing and hearing, or the performance of any function, will contribute in some degree, perhaps, toward recovery. Every man is bound to know all he can concerning his patients. The improper performance of any function may militate against recovery, but one should not hastily argue that chorea is caused by an error of refraction, because such patients are very often hypermetropic, myopic, and astigmatic. The large majority of the world are thus affected, yet cases of chorea are exceptional.

Dr. C. S. Bull, of this city, prepared a paper, showing the conclusions I have already stated, which was published in the *Medical Record*, after having been read before the New York Medical Journal Association. [See *Medical Record*, vol. xii., page 339.]

Pursuing this line of investigation, I examined twenty students from this college, who never had had severe inflammation of the eyes, as far as they knew, who had spent their lives in study, but who never had suffered from weakness of vision or asthenopia. I then put them under the influence of the sulphate of atropia, which, as you know, puts the eyes at rest, so that no accommodation can be employed, and I found that a very large percentage, all but one or two of them, were hypermetropic. Of course the inference was that if these men, who had lived all their lives with a degree of hypermetropia quite equal to what was said to be able to cause many serious diseases, and yet did not either suffer in their eyes or in their bodily figure from any nervous disease—the inference, I say, was natural that hypermetropia did not necessarily cause these troubles. I should also say that none of these men were short-sighted. They could all read the bottom line of Snellen's test-types at twenty feet.

These observations gave ground for the suspicion that a majority of mankind are either hypermetropic or myopic, and I believe that these results will be obtained by any examination which may be made among the people of any nation. Dr. Ely has extended the same line of observation to very young children, and has found that of those which were not myopic, seventy-one per cent. were hypermetropic. Now, then, should not a man be very sure of his ground when he states that so many evils flow from uncorrected latent hypermetropia? Should he not at least be a little suspicious that hypermetropia is only one of the factors causing these troubles?

These same remarks apply to uncorrected myopia and astigmatism. Their relief by glasses is a great boon, but there is no proof that they often cause serious reflex phenomena, except such as are intimately connected with the eye—blepharitis, headache, and so forth.

If you will study Donders'* cases, you will see that those people who receive the greatest benefit from the use of convex glasses are chiefly those in whom the hypermetropia is so great that it can be readily discovered. In such cases glasses improve the vision at once, and Donders' discovery has done for them what I said at the beginning was of the greatest value, and conferred benefits upon the human race which cannot be easily overestimated. Unfortunately for this country, we might have had the advantage of Donders' discovery years before, had Prof. Dewey's article been published in a medical instead of a chemical journal, for our American professor had fully shown the value of convex glasses in correcting hypermetropia. Donders never made any such claims for convex glasses as have been made by those who cure general disease with them. We find in his work very little indeed about these reflex phenomena which are cured nowadays, or said to be cured by the use of glasses. Mention is made of headache, a constricted feeling about the edges of the lids, watery eyes, photophobia, in short, symptoms which have been grouped under the term asthenopia, but nothing whatever is said relative to the cure of chorea, or epilepsy, or hystero-epilepsy, or general disease. That was reserved for later investigators.

Since the promulgation of the theory that chorea is caused by an error of refraction, and is cured by wearing glasses, a further step has been taken by its author, Dr. Stevens, of Albany. So far as I can judge from his paper, Dr. Stevens no longer has the faith in the cure of chorea by the use of spherical and cylindrical glasses that he once had, but he now believes that a proper training of the ocular muscles, by means of prisms and tenotomy, will not only cure chorea, but also epilepsy. At the late meeting of the Medical Society of the State this gentleman read a paper, in which he claimed *that functional nervous diseases are beyond any and all other causes dependent on anomalous conditions of the refraction or accommodation of the eyes, or upon imperfect action of the muscles of these organs.*

The cases presented by Dr. Stevens as illustrations of his theories, and which are said to have been cured by glasses, exercise of the ocular muscles, or by division of the recti, are epilepsy, hystero-epilepsy, chorea, intense and long-continued headaches. A course of treatment by means of prisms was said to be often effectual. In case this failed, division of one set or other of the muscles was said to be curative in many cases.

Let us now study for a few minutes together the effect of prismatic glasses when placed before the eye.

These two diagrams† represent a convex and a concave lens. If you divide the convex lens in the middle, you will have two wedge-shaped pieces of glass, or prisms, with their apices forming the outer extremities of the lens. If you divide the concave lens in the same manner, you will have two wedge-shaped pieces of glass, or prisms, with their apices in the center.

Now remember what a convex lens does. It converges the rays of light in the manner shown in the diagram;* the light is refracted toward the bases of the prisms.

What effect has a concave lens upon rays of light? It disperses them—that is, the rays of light are bent toward the bases of the prisms of which it is made up.

This makes you ready for the experiment which I will perform. I take a colored glass (red), put it before one eye, and then I put a prism, with its base upward, before my other eye, and then I look at the candle, twenty feet distant, and describe what I see. I see a red light above, and I see the actual light below. I have double vision. My prism has bent the rays of light coming from the candle toward its base, and has made an image upon that eye at a different point from that at which the image had been made upon the fellow eye; consequently, instead of having single binocular vision, I have a double image and double vision with two eyes produced by prisms. Now let me reverse the conditions, and place the base of the prism before the internal rectus. I see two images, the red light upon one side and the natural light upon the other. The displacement is to one side instead of being above or below. By using my external rectus muscle very vigorously, as impelled to by the desire for single vision, I can blend these images.

I place the prism before the opposite eye, and by a strong action of the internal rectus muscle I can again blend the images. A point is reached when I use a very thick prism, when the images on the retina are so wide apart that I cannot blend them with all the power I am able to exert with the rectus muscle.

The eye is turned excessively inward or outward as may be necessary to neutralize the displacement of the retinal image made by the prism. This is what is technically called "overcoming" a prism, and blending the double images caused by it.

What occurs when I blend these images in this manner? This excessive convergence or divergence is, of course, a squint. If you were to look through the glass prism in front of my eye as I am performing the experiment of blending the images of the light, you would see that my eye was squinting.

The theory of Dr. Stevens is, that if a patient is suffering from persistent headaches, or from nervous phenomena of a vague sort, or from general constitutional disease, such as hysteria, epilepsy, and hystero-epilepsy, he may often be relieved by training of his external muscles by the use of prisms. The experiments I have made show the kind of training the muscles receive. Unless a theory is contrary to all the laws of common sense, it is not scientific to deny the possibility of its truth until it has been tested by the accumulations of facts bearing upon it. I will not, therefore, stigmatize this theory, that serious affections of the general system are caused by a want of co-ordination between the recti and the ciliary muscles, or between the different sets of recti, as an absurd one. But I do not hesitate to say that I believe it to be an untenable one. The author's own cases do not seem to me, so far as I have heard of them and seen them, to sustain this theory. As to my own observations, they are all against the theory that gymnastic exercise of the internal and external recti muscles does very much for asthenopia, except in a very few cases; much less for constitutional disease. Indeed, almost all the oculists of my acquaintance in New York use prisms very little indeed, even for the cure of want of power or paralysis of the internal or external recti. Time was when they did, but then their experience has shown that the estimate of their value in local affections was an exaggerated one. But let me recite you a specimen case which I have lately seen, and which induced me to speak to you upon this subject;

A young woman, æt. 19, was brought to my office a few days ago, on account of a headache, which was said to be constant during the day, but not of sufficient severity to interfere with sleep at night. She was found to be myopic and astigmatic, but the correcting glasses made her vision normal. She was a pale, delicate-looking young person. What do I mean by delicate? A delicate person is one whose muscles are not well developed, who is not capable of continued physical exertion, does not bear extremes of heat or cold well, has a capricious appetite, indigestion upon the slightest provocation, cold hands and feet. This patient had suffered the loss of two members of her family from a disease which seemed, from the history obtained, to be of a tuberculous nature. Her father was a strong, robust man, and exceedingly well. Her mother was said to be strong and vigorous. We examined her vision, with the result indicated. We examined her internal recti muscles, and found that she was able to overcome a prism of 30° refractive power at a distance of ten inches.

The prism required by both myself and Dr. Ely, under the same circumstances, was also noted.

Dr. Roosa has the power to overcome a prism of 26°. Dr. Ely can overcome a prism of 24°.

Besides, the external recti muscles of this young woman, which are never so strong as the internal recti in a normal condition, overcame a prism of 18°. Dr. Roosa had the power to overcome a prism of 17°, and Dr. Ely only a prism of 10°. The results of the examination of the muscles of Dr. Ely and myself show about what men can do with their eyes; for we are both well, yet our ocular muscles are not as strong as those of this patient.

The father of this patient is a physician, and he informs me that this headache was attributed to a want of power or of co-ordination of the internal recti, and that exercise by means of prisms having been tried in vain, it was now advised that the external recti muscles be cut. Do you think that the appearance or the history of this patient proved that her headache had anything to do with the condition of her eyes? I do not. Her myopia was corrected, and her muscles, as shown by tests, were in as good a condition as those of men who use their eyes constantly. It is not logical, I think, to conclude that her headaches were caused by trouble with her ocular muscles. In my opinion the headache of this young woman depended upon the obvious anæmia and other general conditions favorable to its existence. Fresh air, iron, good food, may do something for her, but glasses will only correct her myopia, and division of the recti will produce double vision. Such an operation on such a case is, in my opinion, an unjustifiable one. She needed no operation. She *did* need red blood-corpuscles, and hence all the oxygen which pure atmospheric air could give her. She *did* need the very best kind of food, carefully chosen and most properly prepared, and she also needed all that a carefully-regulated mode of living and exercise could bring to her. Besides, she needed to have her eyes thoroughly let alone; and that is what I meant when I said at the beginning of this lecture, that if man learns when to do nothing he has learned a great deal.

I have seen no cases of epilepsy or chorea that are benefited or cured by the use of spectacles or prisms. I have seen several such as the one I have detailed, where they have failed to relieve much less serious diseases. My opinion is that even in the matter of the relief of weak eyes, or what we call asthenopic symptoms, the value of glasses is more circumscribed than was supposed when Donders' discoveries became the common property of the profession. This seems to be the opinion of those who participated in the first triumphs that ophthalmology won, when the ophthalmoscope and the value of correcting glasses were discovered. Now that we have come to the proper estimate of their value in local affections, we are asked to believe that a panacea is found in prisms and division of the external muscles for diseases of the nervous system. I for one cannot accept this new and very meagerly-supported doctrine. All the philosophy of disease is against its truth. But before this, for our philosophy may be wrong, the facts are, in my opinion, entirely wanting to sustain such a doctrine.

I believe that when the argument that convex glasses, prisms, and tenotomy, in general disease, has been fairly understood, and been fairly put before the profession, they will see that it is probably not founded upon accurate observations. I do not know that I can add to this general statement. To recapitulate: Glasses for the old, as invented by an Italian; for the short-sighted, as invented by an unknown man; and for the young who are hypermetropic, as their use was suggested by Donders, are an inestimable boon; but it remains to be proven that the use of glasses, either convex or prismatic, or division of the external or internal recti muscles, will cure any constitutional affections, such as chorea, epilepsy, and hystero-epilepsy.—*Medical Record.*

THERE seems, says the *Natal Mercury*, to be no limit to the diamondiferous wealth of South Africa. New rushes are of weekly occurrence, and Jagersfontein is producing monster gems. Kimberley has now become little more than a capitalists' mine, so that the new diggings will prove godsends to the poor men. A person qualified to judge stated lately that the out-turn of the diamonds last year was $40,000,000, of which not more than one-tenth remained in the country.

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* A clinical lecture by D. B. St. John Roosa, M.D., Professor of Ophthalmology in the University of the City of New York.

* "Accommodation and Refraction of the Eye."

† A reference was here made to diagrams on the blackboard.

DANGER FROM CONTAGIOUS DISEASES AFFECTING THE LOWER ANIMALS.

By PROF. STALKER.

WE are appropriately warned against being over-anxious about what we shall eat or what we shall drink or wherewithal we shall be clothed. This injunction, in some of its features, is conformed to with a literal strictness worthy of high commendation. But it is to be feared that, unless the text is subjected to some sort of qualifying interpretation, it would be "more honored in the breach than in the observance." The relation of our food supply, especially that portion of it derived from the animal kingdom, to diseases affecting the human family, is an important question There is probably no subject on which the general public so much need enlightenment as some of the simple facts in sanitary science—especially the relation of animal food to certain kinds of disease, the liability of many forms of contagious disease affecting the domesticated animals being communicated to man, and the means by which such diseases are propagated. There are certain facts pertaining to this question that appear from time to time in newspapers and periodicals, and the reading portion of the people are sufficiently warned of the danger. But there are many others that go unnoticed because of their simplicity, or because of the whole truth not being known. There are probable dangers against which the people should be warned, though no positive proof of such danger exists.

Nearly every one is aware that the tissues of various species of the lower animals are liable to become the abode of entozoa, or low forms of animal organisms, which in turn may find their way into the human body and become the source of serious results. These may pass the larval or immature portion of their existence in the tissues of the lower animals, and the mature form in man. Such is the life history of the tapeworm. One species of this parasite is derived from a small larva found in the flesh of the ox; another from the muscle of the pig. These are minute worm-like bodies that must rely for their perfect development on the chance of being eaten by that particular species of animal the alimentary canal of which affords a convenient home and proper condition for growth and nourishment. Nature, by adapting the appetite of man to pork and beef steak, and the preference of the parasite for the human intestine above all other habitat, has greatly diminished the chances of its extermination for the want of a congenial home. These larval or encysted forms are known as measles in pork and beef. One or more individuals in almost every community can tell from experience the nature and effects of the adult form, or tapeworm of the human body.

One of the common species of entozoa liable to be obtained from the flesh of the pig is the *Trichina spiralis*, which attains both the larval and adult forms in the same individual, whether the host be man, pig, rat, or other animal. The cysts containing the larva are found in the muscle the same as the measle. When the flesh is eaten by man, the action of the intestinal juices digests the cyst, the larva is liberated and rapidly reaches maturity and deposits a crop of eggs. In a few days these are hatched, and the offspring begin their meanderings to the muscular tissues in various parts of the body. This migration produces one of the most alarming forms of parasitic disease. The pain produced by the burrowing of the larva through the flesh is often intense, and in a large percentage of cases death ensues at this stage. The number—often amounting to millions in a single mouthful of meat—together with their inaccessibility in the muscular tissue, renders treatment of little avail. Pigs evidently suffer less than man from the effects of trichina, for trichinous pork is often obtained from pigs that to all appearances are perfectly healthy. The apparent health of the animal, or the natural appearance of the flesh to the unaided eye, are not sufficient evidence that the meat is a safe article of food. The writer has had occasion to examine specimens of meat against which there was not the slightest suspicion till the disease and death of several persons from eating the same kind of meat led to the examination. What to the naked eye appeared to be a perfectly healthy pork steak, under the microscope proved to be the abode of millions of encysted trichina.

All these and many other parasitic forms are to be found in meat produced on Iowa farms. Doubtless tons of such meat are consumed in our State every year. It is fortunate that the preparations of meat for the table usually proves destructive to these parasites. A temperature of 160° or 170° destroys the vitality of the larva, thus rendering the meat, if not an agreeable object of contemplation, a safe article of food. Thorough cooking is the only safe precaution. Rare meat, with the blood dripping from it, as it is often seen coming on to the table, has never reached a temperature that would make a trichina feel sufficiently uncomfortable to make him roll over in his nest.

Meat is not the only article of animal food that should be subjected to careful scrutiny. The milk of unhealthy cows should be discarded as an article of food. Cows may suffer from many diseases without any appreciable danger from the use of the milk. Again there are other forms of disease that render the milk unsafe for food purposes. Among these may be mentioned *Tuberculosis*, a disease of cattle usually affecting milch cows. Several cases of this disease have come under the observation of the writer on farms where cattle were well cared for. It prevails in all countries, and its nature and development may be considered as identical with tubercular consumption in the human family. Those who have witnessed the slow and gradual decline of consumptive patients should be able to recognize a case of tuberculosis in the cow. The similarity between the diseases is so striking that experimenters have turned their attention, with the most painstaking care, to the establishment of their identity. The result of these experiments has been to establish the fact that tuberculosis can readily be communicated from one animal to another. If portions of the lung or other affected parts be taken from a cow that has recently died from tuberculosis, and the same be fed to pigs, rats, or other animals, they will soon become affected with the same disease. This experiment has been repeated so often that the development of the disease under such circumstances can hardly be called in question. A number of experiments have been tried to test the virulence of the milk from tuberculous cows; while attempts to develop tubercles in animals by feeding them on such milk have failed in a large number of instances, enough have succeeded to condemn all such milk as an article of food. If the milk of tuberculous cows will develop the disease in small animals, such as have been experimented on, there is very strong presumptive evidence that it will develop the same disease in man. It is a fact but too well known that the two diseases, or the same disease affecting both men and cattle, is alarmingly prevalent in many portions of our country. How many cases of strong young persons falling victims to consumption have come under our observation, where there was no family taint or exciting cause to assign as an explanation? There is no question in the whole range of sanitary investigation that possesses more vital importance than the relation of these two diseases.

Glanders, the most loathsome disease to which horses are subject, prevails to a greater or less extent in various parts of the State. While it is generally known as a contagious disease among horses and mules, it is not so generally known that it is readily communicable to man. Inoculation is probably the only means through which man is in danger of contracting the disease. But the liability from this source is so great that it is exceedingly dangerous to handle horses suffering from the disease, without being fully apprised of the danger and observing the necessary precautions. The virus falling upon any portion of the body where the skin is broken is quickly taken into the system and develops the disease with all the characteristics observed in the horse. Medical and veterinary journals record frequent deaths from glanders.

Ten fatal cases were recorded for a single month in the city of Havana during the present summer.

Typhoid fever, while a comparatively rare disease among the lower animals, occasionally makes its appearance with remarkable violence. But whether it is considered from the standpoint of its transmissibility from one species of animal to another, or from its peculiarities in the same species, it is a disease that should be far better understood by the people at large than it now seems to be. The fact that the contagium, or poisonous principle, is not conveyed from one individual to another in the same manner that the contagium of whooping cough and scarlet fever are, often leads to the fatal delusion that the disease is not "catching." While the danger from approaching a typhoid patient is almost zero, the virus, under favorable circumstances, is as active and certain in its results as that of small pox. While the air is not filled with the specific germs of the disease, the dejections from the body are, and when these are favored with the conditions favorable for the development, the only question as to the reproduction of the disease is the question as to whether they will again find their way into the system of a suitable individual. If this fecal matter is not subjected to the action of strong acids or other powerful disinfectants, and is thrown upon moist soil, the conditions are highly favorable for the reproduction of the poison.

This contagium vivum is readily carried by the water percolating through the soil or flowing over it, and thus often finds its way to wells or other water supplies. This hidden process by which the virus germs are reproduced and vivified is all the more dangerous because of its obscurity. Thus the active agencies in the disease may be undergoing development for months after the disappearance of the disease from a community, and would never be known but by their effects. The innumerable channels through which these poisonous germs may find their way back to the body render it an important matter to take every precaution to effectually destroy their vitality by the use of powerful disinfectants.

There are other diseases peculiar to the lower animals alone that have not been so thoroughly studied, and consequently the method of reproduction is not so well understood, that should nevertheless be guarded against with the same care. Among these may be mentioned the so-called hog cholera, a form of fever closely allied in some of its peculiarities to typhoid. It is not positively known that the virus, like that of typhoid, will remain in the soil and retain its activity after it has filtered through into wells and other reservoirs, but too much precaution cannot be taken to prevent the spread of the disease through such means, till proof is obtained that it no longer exists.

It is a well-proven fact that the virus will retain its activity for a long time in straw and other litter, and it is by no means improbable that it may be carried to long distances by either surface or underground streams.—*College Quarterly.*

A LESSON ON CURARE AND OTHER POISONS.

A RECENT number of *Le Practicien* contains a pleasantly written and withal instructive dialogue between a physician and a despondent patient on the subject of suicide. The young man has made up his mind to shuffle off his mortal coil, and resorts to his medical adviser to ascertain the least disagreeable and most prompt method of making his quietus. "To be or not to be," is no longer a question with him, and he only desires the most agreeable and speedy passage across the bourn. The doctor first suggests a leap from the tower of Notre Dame or from the Bastille column, as a pretty certain means, and the suffering following which could not last long. The applicant, however, declares that he would rather live 100 years than make such a display; he has too much self-respect to make a mash of himself, and besides he has heard of persons attempting suicide in this manner being caught in the masonry, and who during their suspension have been led to change their minds.

Drowning is suggested, but his discolored and puffed-out corpse spread out on the flags of the morgue at once disposes of that idea.

Various other methods, including the rope and the revolver, are mentioned, only to be rejected because of their vulgar and disgusting concomitants, and the question of poisons is considered. The doctor takes the would-be suicide to his laboratory, where the effects of various poisons are witnessed on animals. Fifty centigrammes (8 grains) of strychnia mixed with lard are given to a dog. The amount is ten times as much as is necessary to kill the animal, but being mixed with fat its absorption is delayed and they wait for over an hour, when, see! the poor beast locks its jaws, convulsive shudders seize his limbs when any one approaches him, and his muscles become as iron rods. His face betrays his suffering, for intelligence is sharpened with the pain; he longs to cry, but the rigidity of his larynx makes him voiceless, and death supervenes from suffocation when the respiratory muscles can act no longer. The exhibition puts strychnia out of the question.

Arsenic and phosphorus are spoken of, but the possibility of suffering whole days of martyrdom from colic from the former, and the fearful epigastric and abdominal pains of the latter, with the bare chance of recovery only to suffer through life with icterus and albuminuria, dispose of these drugs.

"But see, doctor, what has that great setter dog taken? He is but lightly fastened to his plank, and that calm-looking gentleman beats him heavy blows on the most tender parts, and yet he neither moves nor barks nor shows the slightest indications of suffering." Do not trust appearances. That dog is curarized, and is being kept alive by artificial respiration. Now they are about to experiment on a squirrel. A few drops of a thick solution of curare are injected beneath his skin, and he is let loose in his cage. For three or four minutes he seems to feel nothing; then irritated with a slight pain, he appeals to his masters from his highest bar. Soon fatigue overtakes him and he drops to the floor. He turns his head and takes the nut offered him, but soon puts aside his favorite food; his eyes close, and respiration ceases although the heart still beats.

Surely curare must be a good thing to suicide with, for here is death without spasm or convulsion or other evidence of suffering. Wrong; a more frightful death can scarcely be imagined. Curare acts on the nerves of movement without affecting those of sensibility. The dog feels intense suffering, but can make no movement to express it. That seems difficult to prove, but it may be shown thus: tie a bandage around a frog in such a way that all the system of nerves shall be subject to the influence of the poison except those of the thigh. He is then curarized, and all the nerves of movement are paralyzed except those of the hind legs. The convulsions of the hind feet will show the suffering of the poor little beast. If now the animal be pricked in the fore foot, the head, or the chest, he can make no movement to avoid torture, but the desperate convulsions of his hind legs, which are thus induced, show how sensitive he remains to pain.

A man poisoned by curare would watch his own agony without the power of making a gesture, and would feel paralysis creeping gradually over his limbs, his head, and the muscles of his jaws. In intense vividness would he realize one of those horrible nightmares in which one struggles to fly or cry, but feels nailed to the ground, with his voice arrested in his throat. While preserving the most placid appearance the anguish of suffocation would creep on, the muscles of inspiration being affected in their turn, and the air no longer reaching the lungs. The heart would keep on beating and the brain would retain all its intelligence, anticipating and analyzing every step toward its fatal termination.

The young man does not select his poison, but asks for further time for reflection.—*Therapeutic Gazette.*

EFFECTS OF INHALING OXYGEN.

A YOUNG Frenchman, M. Aune, has lately made experiments on himself relative to this question, which he has chosen as the subject of a medical thesis. The experiments lasted four weeks, during which time he submitted himself to a uniform *régime* as regards quantity and quality of food, muscular exercise, and intellectual work. He took oxygen only during the second and the third week, inhaling between forty and eighty liters of it daily, but during the whole time he made a careful record of temperature, pulse, respiration, etc. The conclusions arrived at are briefly as follows: Inhalation of oxygen made under physiological conditions do not cause any inconvenience. One may absorb one hundred liters, and even more, daily. Oxygen increases the appetite and develops the functions of assimilation; and on this account it tends to increase the weight of the body. It produces a slight intoxication and tingling sensations in the extremities. It raises the temperature very slightly. Under its influence the respiratory movements and the pulsations become more numerous. The emission and secretion of the urine are not affected, nor is its constitution. Oxygen has an incontestable action on certain elements of the blood; it increases the number of red corpuscles and of hematoblasts, and the richness of the former in hemoglobin. It has no influence on the white corpuscles. M. Aune did not experience that sensation of heat in the chest of which some authors have spoken in connection with this subject. Commenting on M. Aune's experiments, M. Hoyem remarks that the effects are only temporary, and that while inhalation of oxygen may be of service through favoring assimilation, it could not be made a definitive treatment, and it would be necessary always to administer iron in addition. The inhalation gives very good results in the case of dyspeptic phenomena and obstinate vomiting.

THE AMERICAN PHARMACEUTICAL ASSOCIATION.

TWENTY-EIGHTH ANNUAL MEETING, HELD IN SARATOGA, N. Y., SEPTEMBER 14, 15, 16, AND 17, 1880.

THE association met in the concert room of Congress Hall.

President Sloan delivered the annual address, in which he referred to important changes in the rules of the association, and the general progress made in pharmaceutical science, and then discussed at some length the topic suggested by a paper read by James G. Steele, on "The Medicinal Plants of California," read at the last meeting of the association. He considered the effect produced on native medicinal plants by the destruction of our forests, and asked: Can they be successfully and profitably cultivated, and will the cultivated possess the therapeutic virtues of the natural plants? At present these questions cannot be satisfactorily answered, but they are of sufficient importance to demand the earnest attention of pharmacists.

James Thornton Shinn was unanimously elected president for the year.

The Chairman of the Executive Committee, Geo. W. Kennedy, then read the annual report of the committee, which was accepted.

The report showed that the total membership at the close of the last annual meeting was 1,208. Since that date there had been a total loss of 58 members, leaving 1,150 in good standing.

Charles F. Fish, of Saratoga, read a paper on

THE MINERAL SPRINGS OF SARATOGA.

The author first gave a brief historical sketch of the village of Saratoga and its surroundings, and then proceeded to speak of the theories concerning the sources of its mineral waters. All the rocks of this county belong to the lowest systems of geological formations, and are both metamorphic and sedimentary in character (the geological formations were represented upon a chart). The theories concerning the origin of the mineral waters are two in number.

First, that they are produced by the process of displacement or percolation of the surface water through the rocks, and carrying with it the various constituents of which the rocks are composed, and reappear at the "fault" in the geological strata caused by an upheaval of remote origin.

Second, that the water derives its mineral properties at the "fault," and is essentially unimpregnated until that point is reached, and that its mineral constituents are obtained from the heated interior by the process of sublimation and subsequent absorption, while the gases are also derived from the same source in a free state.

The author then described the method of securing the mineral springs of this locality. The depth at which the rock is situated below the surface varies from fifteen to fifty-seven feet. The springs secured by drilling into the rock vary in depth from fifty to three hundred feet in depth, and the temperature of the water obtained is practically isothermic, the maximum being 52° and the minimum 40° F., and the flow and temperature being uniform throughout the year. The Geyser, Vichy, Champion, Kissingen, and the so-called Magnetic (which is devoid of magnetic properties) springs were obtained by drilling.

The author then gave a classification of mineral waters, and subsequently referred to the therapeutical application of this natural remedial agent.

FLUID EXTRACTS.

Dr. E. R. Squibb, of Brooklyn, asked Prof. Diehl whether or not he noticed any considerable proportion, with a weak percolate, that remained insoluble in the fluid extract; and also whether he noticed that the residue of the evaporated portion was of the same character as the contents of the reserved portion. He regarded these as prime points in considering the value of the process proposed for making fluid extracts. The value of the claim for the process of repercolation depends particularly upon the total avoidance of heat in the making of fluid extracts, and, if it be of any force at all, the above questions were pertinent to it.

Another point was with reference to the adoption of volume for weight, and not weight for weight, as decided upon by the Committee on the Revision of the Pharmacopœia. He asked whether any experiments had been made to determine whether or not the menstruum used might not be so modified as to bring the matter within practical reach; that is to say, cannot the menstruum be so modified as to represent weight for weight? The point made was that a menstruum that did not dissolve the constituents of the drugs afterward, although it might extract them, would not produce a liquid that contained the constituents of the original substance.

Prof. Diehl replied that in his first paper on this subject he had stated that when the original menstruum was restored in the proportion in which it was before evaporation, the extracts were almost always dissolved again. That point he has settled with regard to the fluid extracts upon which he had made experiments previously, and, in making the experiments reported in the present paper, he had found that the same thing held true with reference to nearly all of them. On general principles he was opposed to any such method, because it will lead us to adopt a menstruum which will not be proper for the best extraction of a drug, holding everything extracted in solution. He thought, however, that if a reasonably fair set of formulæ could be obtained for the Pharmacopœia, we should be reasonably satisfied.

Prof. John M. Maisch, of Philadelphia, remarked that, while he believed with Dr. Squibb that it would be well to harmonize volume and weight, he would go even farther, cite instances in which that cannot be done, and give it as his opinion that fluid extracts should be made weight for weight. He thought it was a great mistake to use only weights in the Pharmacopœia, except with reference to one class of preparations.

FERRIC HYDRATE.

The next paper, an answer to Query 20, was read by G. F. H. Markoe, of Boston.

"What are the advantages and objections to preparing ferric hydrate by the use of concentrated solutions of ammonia and ferric sulphate, as compared with the use of diluted solutions, with the special object of employing the ferric hydrate in making the scale salts of iron?"

He advocates the use of the dense form of ferric hydrate for use in making other iron preparations. This dense hydrate is, of course, obtained by using more concentrated solutions. It may be prepared either with ordinary or with stronger water of ammonia.

Hydrated ferric oxide, as an antidote for arsenic, should be prepared from *dilute* solutions, in order to insure more rapid solubility in acids.

Dr. Squibb thought that if Prof. Markoe had extended his observations to the precipitate afterward, and said how much sulphate of ammonia was left in the iron, he would have covered the ground more closely. He thought Prof. Markoe would have found, by so doing, that considerable sulphate of ammonia was left in the iron precipitated, and that it was not washable out, in the ordinary sense, and also that it was very effectual in rendering the hydrate soluble in citric acid, and other things added afterward.

Prof. Markoe remarked that he was aware of the fact mentioned by Dr. Squibb, in a chemical point of view, and that he recommended the preparation exhibited merely for specific purposes.

RHAMNUS PURSHIANA.

The next paper was an answer to Query 12, and was read by Geo. W. Kennedy, of Pottsville, Pa.

"*Rhamnus purshiana* has attracted considerable attention as a purgative remedy. What forms of galenical preparations of it are desirable, and how should they be prepared?"

The writer recommended a fluid extract and an elixir as the only preparations, to his knowledge, at this time prescribed and used. He recommended an elixir made from the weaker pharmaceutical preparations, because it is more palatable.

ASPIDIUM MARGINALE.

Geo. W. Kennedy also read an answer to Query 16.

"*Aspidium marginale* has been found by Mr. C. H. Cressler to be very similar in its medicinal value to the European Aspidium *filix mas*. Can the rhizome of the American plant be obtained in quantities? If so, should the latter not be recognized by our Pharmacopœia in place of *filix mas?*"

The answer was, that, since its therapeutic properties have been found efficient, there should be no objection to its introduction into the Pharmacopœia, and the two substances used indiscriminately in the preparation of the oleoresin.

The next paper was an answer by S. L. Coffin, of Chicago, to Query 17, and was read by Dr. H. J. Menninger.

"Aromatic spirits of ammonia has been proposed as a menstruum for exhausting lupulin. Has this any advantage over alcohol?"

He stated that he finds them equally good for this purpose. He has also learned from physicians that the tincture prepared with the aromatic spirit of ammonia presents no therapeutic advantages.

LEPTANDRA.

J. U. Lloyd, of Cincinnati, O., read a paper in answer to Query 21.

"The resin of *Leptandra virginica* (the leptandrin of commerce) varies much in appearance and sensible properties. To what cause are these varying results to be attributed? What is the best process for the preparation of the resin, and what is the average yield of the root?"

The commercial "leptandrin," as made by different manufacturers, varies considerably in appearance. This is owing to two causes, viz.: first, to a difference in fineness of powder; and second, to a difference in composition.

If an alcoholic tincture of the root of *Leptandra virginica* is evaporated to a thick sirup, and the latter is poured into cold water, a black, tarry substance separates. On being washed with water, it becomes tasteless, and may be dried and powdered. At present, manufacturers probably prepare "leptandrin" by another process, and not by precipitation. Prof. John King made his original preparation from the root in this manner. But his therapeutical observations are based on the results obtained from a dried mixture of the aqueous and alcoholic extract.

"Leptandria" was discovered by Merrel, in 1850. This substance, however, has been found to be devoid of medicinal properties. The active principle has so far not been isolated; yet it is well known that the root, as well as the active kinds of "leptandrin," possess laxative properties.

Mr. Lloyd exhibited a large mass of the precipitates above mentioned, the result of working with 1,000 pounds of the root.

FRUIT SIRUPS.

A. G. Vogeler, of Chicago, read a paper in answer to Query 10:

"Fruit sirups; and essay on them, with special reference to their probable introduction into the next Pharmacopœia."

These may be prepared either by combining the juice, expressed from the fruit with sugar, or the uninjured berries are mixed with the sugar, when the latter will extract the juice, leaving the berries shriveled and tasteless. Among the fruit sirups discussed by Mr. Vogeler, *Syrup of Raspberries* is the most important. He quotes the following different methods of preparation:

1. Contuse the berries, put them into a suitable vessel or vat, add two per cent. of sugar, and allow them to ferment at a temperature of 70–80° F. from three to four days, until the pectin has separated, and no more signs of fermentation are noticeable. Express, let the juice settle for a few days in a cool place, decant and filter. Preserve the juice by Appert's process (introducing the juice into stout bottles, not quite filling them, corking, setting them into a vessel full of cold water, with straw packed between them, so that the water reaches up to the shoulder, and slowly heating the water to boiling; then securing the cork with wax), or convert it into a sirup by dissolving nine parts of sugar in five of the juice, and heating to boiling.

2. A better way is to add at once to the freshly bruised fruit five to six per cent. of alcohol; then proceed as in No. 1.

3. Crush the berries in a glass vessel with a wooden pestle, add five to ten per cent. of cane or grape sugar, and allow to stand, stirring occasionally. When fermentation is completed the juice becomes clear. Filter and bottle.

4. Put 4 lb. of the berries into a china bowl with 1 qt. of water containing 2½ oz. of citric acid in solution. Let remain twenty-four hours. Strain, taking care not to bruise the fruit. To 1 pt. of the clear liquid add 1½ lb. of sugar, and stir until it is dissolved.

5. Proceed as in No. 1. When the fermentation is nearly over, express the juice, and add to each pound of it f. ℥ j. of deodorized alcohol. Set it aside for one night, filter and bottle, or convert into sirup.

6. Macerate the berries interspersed with layers of sugar, 1¾ lb. to 1 lb. of berries, for twenty-four hours, in a cool cellar, and drain off the juice. Preserve by Appert's process.

7. Add to the foregoing product some alcohol or a little bisulphite of lime.

8. Pure fruit juice, ℥ xvi.; dil. acetic acid, f. ℥ j.; water, f. ℥ vii.; granulated sugar, 3 lb. Dissolve without heat. The acetic acid is considered by the author as objectionable.

The minutes of the present session were read and approved, and the President then declared the association adjourned, to meet in Kansas City on the fourth Monday of August, 1881.

The whole number registered at the twenty-eighth annual meeting was one hundred and eighty-seven.

DR. TANNER LECTURES.

On the evening of September 9, at Booth's Theater, in this city, Dr. Henry S. Tanner, the famous faster, delivered a lecture giving his views upon what lessons had been conveyed by his prolonged fast.

We find the following summary in the daily *Sun:*

He said that in 1877 he became thoroughly convinced that abstinence from food would cure many diseases that now baffle the skill of physicians. He told of his forty-two days' fast of that year, and of his disappointment because the truth of his story was doubted. He had read with interest the case of Mollie Fancher, and was exasperated at the treatment she received from Dr. W. A. Hammond. When Dr. Hammond published his challenge to Miss Fancher to submit to a watch, he at once wrote and offered himself as Miss Fancher's substitute. He pronounced Dr. Hammond guilty of equivocation, misrepresentation, and falsehood, and said:

"In all my dealings with men I never met one so devoid of truth and regardless of all the courtesies due from one man to another."

He denied that he had been unwilling to accept Dr. Hammond's terms, and declared that Dr Hammond had been falsely pretending he was willing to wager $1,000 that no one could live forty days without food or water. He declared positively that he had offered to submit to any conditions that Dr. Hammond might impose, only stipulating that the room should be large, light, and well ventilated.

Dr. Tanner said that even Dr. Hammond had agreed with the general opinion that the fast was honestly conducted. There was not so much unanimity, however, about the value of the forty days' fast to science. Not only the fast, but the rapid recovery after it, was eminently successful in upsetting the prevalent theories of physicians. He would use the evidence that the fast was honestly conducted as a weapon against the established views of medical experts on the subject of both fasting and recovery from the effects of fasting. He claimed that it established the truth of one belief he had held for many years, that the sanative, or healing principle, is in the man, and not in the medicine. In all functional or organic derangements of his own body he had implicitly relied upon this self-healing principle to restore the equilibrium without the use of drugs. He had unbounded faith in the potency of this God-implanted principle, and it was that faith that enabled him to abstain from food. The same faith enabled him to partake of liberal diet at the end of his fast in the face of the warnings of nearly the entire medical profession, that by so doing he would meet with speedy death. The fact was that the vigorous action of the stomach prevented the disastrous results that were predicted. He knew what he was about when he partook so plentifully of food, and the result was, he said:

"I did not die, as you see. I gained thirty pounds in nine hours. My experience shows the impotence of drugs, the uselessness of mercury and arsenic."

Speaking of the ordinary drug remedies, Dr. Tanner said they reminded him of the man who tried all sorts of things to get rid of the rats in his barn. The last remedy was to burn down the barn. When the people learn the uselessness of drugs there will be fewer seven story palaces built up on cough drops and antidyspeptic pills. He said he was not afraid to step aside from the beaten paths that the followers of Esculapius have so long trod, and would not be bound by the dicta of medical experts of either the allopathic, homœopathic, or eclectic schools. Although the medical uses of abstinence from food had been his favorite hobby, he was not exactly willing to die for it. He thought that if he should live for it, his favorite theory would be more apt to be appreciated.

Dr. Tanner regretted very much that so many simpletons attempt to practice medicine. He said it reminded him of a visit he once made to a sturdy blacksmith who had eleven sons. He asked the blacksmith what he proposed to do with the boys. The blacksmith replied: "I am going to make blacksmiths of the best of them and doctors and preachers of the balance." There is too much intolerance in the profession of medicine—too little effort to teach men the laws of life and health. The successful physician succeeds generally by personal magnetism. He is born, not made.

Dr. Tanner denied that his was an exceptional case. He claimed that it would be of use in convincing people that they could go without food safely twelve or fourteen days where it is prescribed as medical treatment. He claimed also that it would be of use in showing that such abstinence would not be injurious to the mental powers. Another thing proved by it is that the stomach is not made by fasting incapable of performing its functions. If he had done nothing but prove these things, he thought he had proved enough. He thought it was a great achievement to prove that the animal part of us is subjected to the higher powers of the mind.

Dr. Tanner quoted Dr. Carpenter's description of starvation, and claimed to have disproved its accuracy, because, he said, he did not show, while fasting or afterward, the cadaverousness, the secretions on the skin, the fetid breath, the tottering walk, or the decay of the mental powers predicted by Dr. Carpenter. He was convinced that the prevalent idea of medical experts that rest and inactivity were necessary to prolong life during fasting were disproved. He thought he had demonstrated that activity is necessary during fasting, to throw off the impure matter that would otherwise make the fasting fatal. He was also satisfied that his experiment would eliminate from future fasting trials the palsying effect of fear. He quoted several cases where persons have died from imaginary injuries. He claimed to have proved beyond question that people generally eat too much, and he estimated that most persons can live on about the quarter of the food they now consume. Much force is expended in getting rid of superfluous food. That force might be turned into physical or mental labor.

Dr. Tanner specially commended abstinence from food as a cure for dyspepsia and rheumatism. He said that after a fasting for medical purposes there will be a natural call for food, which may then be taken in sufficient quantity. He quoted a letter from Dr. C. A. Wood, of Montreal, who had published his approval of the plan of treating disorders of the digestive functions by fasting. He said that dyspepsia is our national disease, and the best way to get rid of it is to adopt the advice of Shakespeare, and "throw physic to the dogs." Finally Dr. Tanner argued that his two triumphant fastings had proved the immortality of the soul. Although constantly eliminating large quantities of phosphorus in his talks, discussions, and other mental exercises, he claimed that his brain was not injured by the fast he had undergone. This, he said, disproved the materialistic theory of the construction of the mind, and proved beyond question the power of the mind over matter. He had been able to overcome the keenest pangs of hunger by a mere effort of the will. His will was constantly strengthened to enable him to go on with his abstinence. He claimed also to have demonstrated that we depend upon electric influences in the atmosphere for much of our strength. This electric power, he asserted, helps change the venous blood into arterial blood. He further claimed to have proved that there is a life-sustaining force in personal magnetism, or animal magnetism. He trusted that the doctors would be led by his experiments to investigate further the laws of life, so that instead of dealing out drugs they would become the teachers of the nation.

THE EARTH AS SEEN FROM OTHER STARS.

There is hardly anything that could better convey to our minds an idea of the utter insignificance of our earth in stellar space than a representation of the aspect that it would offer us when viewed from the other heavenly bodies. To obtain this view we need not by any means ask our readers to accompany us in an imaginary tour to the fixed stars, for from the nearest of these the earth is invisible, the distance being 225,000 times greater than our distance from the sun. In fact, it has been found by the most eminent astronomers of the age, and the most perfect instruments ever made, that the parallax of the nearest stars does not exceed the four-thousandth part of a degree, or a single second; so that, if the whole great orbit of the earth were lighted up into a globe of fire 600,000,000 miles in circumference, it would be seen from the nearest star only as a twinkling atom; and to an observer placed at this distance our sun, with its whole retinue of planetary worlds, would occupy a space scarcely exceeding the thickness of a spider's web! It will be seen from this, then, that if any of the fixed stars are inhabited, their inhabitants are living in utter ignorance of the existence of our world or of any of the planets of our solar system, and the whole of the latter might be blotted out of existence without any knowledge on their part that such a catastrophe had taken place.

Confining ourselves, therefore, to our own planetary system, it is probable that of three planets the inhabitants (if such there be) have as accurate a knowledge of our planet as we have of theirs; while to the others there is a

great probability that the earth is almost of as small importance as it is to the fixed stars. Let us first travel out to the innermost of the planets, Mercury, which moves in an orbit 37,000,000 miles from the sun in eighty-eight days, thus giving it a year equal to about three of our months. As the earth revolves in a wider orbit, the best time for the observation from Mercury will be when the sun, Mercury, and the earth stand in a line. Then the side of the earth toward Mercury is illuminated, and our planet is seen by the latter as a large, brilliantly shining star, which, in the accompanying cut, is seen proceeding in the direction of the arrow, from west to east along the zodiac.

Seen from Venus, the earth exhibits a much more magnificent aspect. After every five hundred and eighty-four days the two planets are in their nearest proximity, and only about 26,000,000 miles apart. Then the earth appears from Venus like a large, bluish-white, brilliant star, which in size surpasses all others in the firmament. In the accompanying illustration the arrow again shows the direction in which the earth is moving.

From the moon the earth presents a still more gorgeous aspect. Its illuminated side is seen to have a diameter something like four times that of the full moon as seen by us, and far surpasses the sun, as well as the planets, in size. It exhibits phases, too, just as we observe them in the moon, and which are in the most beautiful harmony with the needs of the lunar days, these being equal to fifteen of our days. It is, for example, full at midnight, in the last quarter at sunrise, new at midday, and in the first quarter in the evening; so that its light compensates for that of the sun. At "full earth" the lunar inhabitant can distinguish our seas and continents, and see the white shimmer of our polar snows and ice, and the floating clouds in the air. Our atmosphere, which refracts the light from millions of stars, appears like a wan halo investing our globe.

As for Mars, which is 145,000,000 miles from the sun, the circumstances are essentially different. While the orbits of the foregoing planets are within that of the earth, Mars' orbit lies immediately outside or beyond. To a spectator on this planet the earth will appear alternately as a morning and evening star, shining with considerable brilliancy, and will exhibit all the phases of the moon, just as Mercury and Venus do to us; and sometimes, like them, will appear to pass over the sun's disk like a dark round spot. Our moon will never appear more than a quarter of a degree from the earth, although its distance from us is 240,000 miles. To the Martial inhabitants the earth will appear larger than Jupiter does to us, and will shine with such brilliancy as to be visible to them even during the daytime.

While to the dwellers on Mercury, Venus, the moon, and Mars, our earth maintains the first position among the stars, to those of Jupiter it at once sinks into utter insignificance. The orbit of the latter planet is situated at 496,000,000 miles from the sun, and the distance from the earth varies between 385,000,000 and 625,000,000 miles. It is evident that as the earth never recedes farther than 12° from the sun, it cannot be seen during Jupiter's night, for twilight continues a long time after sunset, and when it ends the earth itself is already beneath the horizon.

This is the only period at which the earth could be visible, for it is then in its "quarter," when it is half illuminated by the sun; even then, however, it is most too small to be seen by the naked eye. So none but astronomers, with their telescopes, could descry our globe from Jupiter; and even then only for a few minutes before sunrise or after sunset, since it quickly disappears, as an insignificant satellite of the sun, in his fiery rays. Now and then, of course, Jupiter's astronomers, in searching for sun spots, may detect a little black dot moving across the solar disk, and which will turn out to be a "transit of the earth," our magnitude having shrunken to such dimensions when seen from Jupiter!

The world of Saturn, with its wonderful rings, is about nine and a half times farther from the sun than the earth is—namely, 909,000,000 miles; and, seen from it, the earth is, at the best, but a mere speck oscillating from one side of the sun to the other. This happens thirty times during the Saturnian year, and never at a greater distance than 6'. Our imaginary view from Saturn embraces an extent of 30° at midnight—that is to say, at the period when the sun, illuminating the planet's immense rings, causes these to appear in its nocturnal sky like two gorgeous arches of light, bright as the full moon, and spanning the whole heavens like a stupendous rainbow. During this wonderful display the Saturnian worlds are undergoing their many quickly-changing phases. The various aspects of the seven moons, one rising above the horizon, while another is setting, and a third approaching the meridian; one entering into an eclipse, and another emerging from one; one appearing as a crescent, and another with a gibbous phase; and sometimes the whole of them shining in the same hemisphere in one bright assemblage, are scenes worthy, indeed, of being contemplated by rational creatures. But the Saturnians know nothing about our earth; for even if, through the construction of immense telescopes, it were possible for them to see it, it would appear to them as nothing more than a miserable little speck on the sun's disk.

Still less visible is the earth from Uranus, which, situated at 1,828,000,000 miles from the sun, receives seventy times less light and heat than the earth does. From here the earth is scarcely any more perceptible even during its transit. Finally, from Neptune, which is 2,862,000,000 miles from the sun, the latter is seen merely as a large star, one-thirtieth of the diameter that it appears to us. To the inhabitants of this planet the earth is absolutely invisible—*nil*; and, if seen at all, it could only be by the aid of most enormous telescopes.

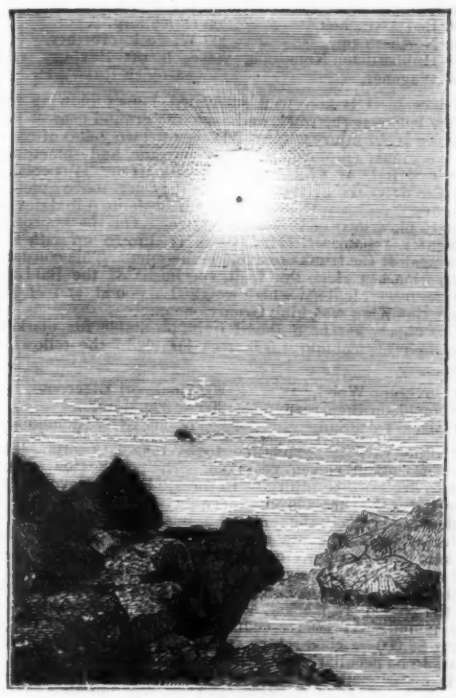
Among all those millions of stars that fill the vast celes-

THE EARTH AS SEEN FROM MERCURY.

THE EARTH AS SEEN FROM VENUS.

THE EARTH AS SEEN FROM THE MOON.

THE EARTH AS SEEN FROM MARS.
(The large star in the middle of the engraving is the Earth.)



FROM JUPITER.
(The black spot on the Sun is the Earth.)

THE EARTH AS SEEN FROM SATURN.
(Through the most powerful telescope the Earth appears as a minute star only.)

HOW THE EARTH APPEARS FROM THE OTHER STARS.

tial space there are only five, then, or at the best only seven, to whose inhabitants (if such there be) the existence of our globe is known. And yet we dare to apply the term "world" to our miserable little speck in the universe!

THE ULTIMATE STRUCTURE OF LIVING ORGANISMS.*

By DR. CARL SEILER.

IN beginning to study the ultimate structures of our own organism and of those organisms, both animal and vegetable, which surround us, it is well to have a plan to go by, and which we can trace out in all its details as we advance in our studies. Such a ground plan in histology is obtained by the division of the different tissues into classes with subdivisions. At a former occasion I made a few remarks on this very subject, but think that they will bear repetition, especially as I intend to go somewhat further than I did before.

All the tissues which make up the living organism naturally divide themselves into epithelial tissues, connective tissues, contractile or muscular tissues, and nerve tissues. The last two may, and are by some writers brought under the general head of connective tissue.

Each one of these classes embraces a variety of forms which, however, in principle and general arrangement do not differ from each other. These different forms we will now consider:

The EPITHELIAL tissue is divided into *epithelium* and *endothelium*. The *epithelium* is found on the surface, and in all cavities which have either direct or indirect communication with the surface. Its office is to protect and to secrete or excrete. The *endothelium* is found only in cavities which have no communication with the surface, and its office is to protect. Thus we find epithelium in the glands, the intestines, the respiratory tract, and so forth; all of which have a more or less direct communication with the skin by ducts or otherwise; and we find endothelium in the blood-vessels, pericardium, peritoneal and pleural cavities; all of which have no connection whatever with the outer covering. Epithelial tissue shows itself in different localities in different shapes, so that we find squamous or scaly, tessellated or pavement-like, columnar and ciliated epithelium.

The *connective* tissues, as their name implies, serve to connect or bind together the different parts of the organism, and they are met with in a very great variety of forms: hard and unyielding, or soft and flexible, elastic or non-elastic. Bone, cartilage, fibrous tissue, tendons, yellow elastic tissue, all belong to this class, as can be clearly demonstrated under the microscope.

The *contractile* or *muscular* tissue naturally is divided into striped or voluntary, and non-striped, involuntary, or organic muscular tissue. The heart muscle, however, forms an exception to this, inasmuch as its fibers are striped, but their contraction is beyond the control of the will. There are, however, a few cases on record of persons who at will could cause the heart to cease in its movements and to start it again.

The *nervous tissue* is divided into central or ganglionic nerve tissue and into fibrous nerve tissue or nerve fibers. The office of this tissue, as is well known to all of you, is to supply the necessary nerve force, or whatever it may be called, which is necessary for the performance of the functions of the other tissues.

There remains one tissue, if such it may be called, which is different in every respect from all others mentioned, and which must be classed by itself—namely, *blood*.

All these tissues, no matter to what class they belong, are made up of cells which are held together either by their own prolongations, as in fibrous tissue, or which are embedded or mounted upon a structureless basis substance called *stroma;* as, for example, in hyaline cartilage, blood, and so forth. In order to understand this, and to gain a clear conception of what is meant by a cell, we will study the changes which a connective tissue cell undergoes in fœtal life as it matures and forms a fiber. We first notice in very young fœtal structures a more or less globular body which exhibits extremely fine granules in an active state of motion within its interior, a limiting wall not being visible however. Some recent writers (Heitzmann and Klein) claim to have discovered that each one of these granules is confined in a mesh of an extremely delicate network of fibrils seen in the globular mass, or brought out by certain reagents.

As the tissue becomes older we notice that the granules all collect at one spot, and that a threadlike projection is grown out from the globular body itself, which latter changes its form and becomes more or less oval, looking very much like a tadpole. Later still, another projection is observed at the other end of the cell, while the body, together with the spot of granules, becomes more elongated, and in that stage it is called a hypolar or spindle cell. A third, fourth, or fifth projection may be thrown out still later, so that the cell assumes the shape of a star, when it is recognized as the fully-developed connective tissue corpuscle.

This same globular body, filled with granules, may, however, develop in a different manner, so as to become a different cell; and, if such is the case, we notice again a collection of the granules in a spot in the first stage of development. The rest of the globule then gradually enlarges in all directions, and when it has attained a certain size a closer aggregation of granules is noticed within the first collection of granules. These spots are called the nucleus and nucleolus of the cell, and they form the germ, so to speak, from which the cell grows and is multiplied by division. This process is a very interesting one, and can frequently be observed under the microscope, when we notice a multiplication of the inner spot or nucleolus, forming two or more nucleoli within the nucleus. The latter then begins to separate into two or more portions, each one of which contains a nucleolus, until they occupy different positions within the cell. A notching of the outer contour of the cell is then noticed at points opposite to each other and intermediate to the nuclei. Finally, these notches grow inwardly until they meet in the center, thus dividing the cell into two portions, each one having a nucleus and nucleolus. This process of splitting or dividing may then be repeated in the opposite direction, so as to produce four new cells, and it may be carried on indefinitely, each one of the portions growing as the original cell did. The original shape of the cell, which thus consists of a nucleus, nucleolus, and a structure supporting the nucleus or germ, which former may or may not be surrounded by a distinct limiting membrane or cell wall, is globular, as everything, large or small, in the universe tends to this shape if suspended in a medium rarer than itself. But such a globular body, if brought into close contact with other bodies of the same density, will assume a shape which corresponds to the amount and the direction of the force of pressure exerted upon it. Thus, a drop of water falling through air is globular, but becomes flattened out into a round disk as soon as it strikes a hard substance. Or, take a number of small balls of soft clay, and lay them upon a glass plate, so that one touches another; then lay upon them another glass plate and apply some pressure from above downward, and you will find that the balls of clay are pressed into six or eight sided disks, as a result of the external pressure which tends to flatten the balls into round disks, and of the internal pressure of one ball against the other. By this illustration you will see that the globular cells, which we have watched growing and multiplying, may assume a variety of forms under different circumstances. But if once a cell has adapted itself to circumstances and assumed a shape demanded by these circumstances, it and its offspring will retain that shape no matter what positions it may be placed in. Of this we have daily illustration in the histology of new growths, where we find a cell transplanted from its normal position to an abnormal one, and yet retaining its shape.

The aggregation of cells to form tissues, and the aggregation of tissue to form organs, will form the subject for discussion at a future meeting.

* A recent lecture before the Biological and Microscopical Section of the Academy of Natural Sciences of Philadelphia.

A NEW YORK ORCHARD.

THE fruit farm of Robert McKinstry, near Hudson, N. Y., contains 33,000 trees—the largest number of apple, pear, and cherry trees, taken, as a whole, in this country, and probably in the world. These trees would form a continuous line, twenty feet apart, from Albany to New York city. His farm of about three hundred acres is wholly planted with fruit trees. The soil is a light, gravelly loam, with a natural drainage, and is well adapted to the growth of fruit. The orchards extend for nearly one mile along the public highway and to over half a mile in the rear. From some points, where a large portion is seen, they appear like a sea of trees. Six miles of orchard roads extend through the grounds for access and conveying away the gathered fruit. From forty to seventy men are employed in gathering, assorting, packing, and drawing to the railway during the busy season, which extends from early in June to approaching winter.

The apple trees, which are 26,000 in number, are planted twenty feet apart, with the intention of removing alternate and diagonal ones when they interfere in growth. The first were planted twenty-three years ago, and the average are about fourteen years old. At present they have full space. For a few years they have borne good crops—two years ago over 20,000 barrels. These are all, or nearly all, sent to Europe, the shipping being commenced in August. Complete arrangements are previously made for this purpose, and in one case Mr. McKinstry received a cable dispatch of the arrival and sale of a consignment ten days after it was sent to Catskill Station. Two or three cars are frequently loaded in a day. They succeed best by being gathered rather early.

The following is a list, with numbers of trees, of most of the apples planted in this orchard:

7,000 R. I. Greening,	200 Jonathan,
7,000 Baldwin,	200 Es. Spitzenburg,
4,000 Tompkins King,	200 Ben Davis,
1,000 Red Astrachan,	200 Oldenburg,
1,000 Northern Spy,	200 W. Seecknofurther,
200 Hubbardston Nonesuch,	200 each of Roxbury and
200 Wagener,	Golden Russet, etc.

The orchard is kept well cultivated, horses plowing the spaces between the rows, and oxen the ground nearest the trees, to avoid injury with whiffletrees. Two yokes of oxen are constantly employed for this purpose, and sometimes four, and four or five teams of horses. Care is specially taken to drive the oxen gently, that they may move quietly, and they soon learn to make voluntarily the required deviations to plow near or between the trees. On the approach of winter, a bank of mellow earth is thrown up with the plow against the trunks to exclude the mice. This constant cultivation has given fine fruit, specimens of the Baldwin having been obtained which weighed a pound, and of the Tompkins King weighing twenty-one ounces.

The cherry has been found quite profitable for market. The orchards contain 4,500 trees, largely of the following sorts:

500 Governor Wood,	200 Rockport Bigarreau,
500 Napoleon Bigarreau,	200 or 300 Morello,
800 Black Tartarian,	200 or 300 Early Richmond,

and other varieties, extending to over twenty sorts. The trees are about eleven years old. The past season, which was so dry as to be injurious to the apple trees, favored the securing of the cherry crop, over twenty-five tons having been sold, with scarcely the loss of a bushel by rotting. The different sorts ripening at different periods prevented the pickers from being overcrowded with work at any time, and not more than thirty-five were required at once, who would gather about two tons in a day. The fruit was sold chiefly in the New York market, at from seven to eighteen cents per pound. At twelve cents, the twenty-five tons would bring $6,000—a good return from forty acres. The soil appears to be peculiarly adapted to the growth of this tree, and it is occasionally necessary to sow oats in the orchard to reduce the vigor of the trees and prevent bursting of the bark. Mr. McKinstry has had in one instance nine bushels of cherries from a tree of the Napoleon Bigarreau.

Among the 2,000 standard pear trees are 700 Bartletts of handsome growth, besides which there are 200 each of Seckel, Sheldon, and Anjou. Beurré Bosc proves one of the best market sorts. We saw very little indication of blight among the pear trees.

The borer appears to be the worst enemy of the apple tree, and the many trees which have been destroyed have been promptly replaced by replanting. The only remedy is opening the holes of this insect with a knife and destroying with a flexible wire. Sometimes a dozen have been found in a single tree. The codling moth has given little trouble. Mice were formerly quite destructive, but they are excluded now by the remedy already mentioned—namely, by plowing up mellow earth against the trees.

Besides the preceding named kinds of fruit, Mr. McKinstry has a vineyard of 1,700 Concord grapes, an orchard of 1,000 peach trees, another of 200 crabs of different varieties, and the highway is lined with 450 maples. He gives constant personal attention to the management of his orchards, which show the superintendence of a skillful hand, although the trees had suffered this year by a long-continued and extraordinary drought.—*Country Gentleman.*

REMEDY FOR THE CABBAGE WORM.

TAKE one-half pound of London purple to thirty pounds of finely pulverized dust of any kind, the finer and drier the better. Pulverize the lumps in the purple with a trowel, and thoroughly mix with the dust, passing all through a meal sieve. Now take some dust in a dish and go over your cabbages when they are dry as possible and when the wind is still. A small pinch is sufficient. Dash this into the heart of the plant, and the almost impalpable dust will fog and penetrate through all the folds and convolutions where the worms have gone, and will settle like a scum of smoke over their moist, soft bodies, and in forty-eight hours the plants are cleared effectually. The first shower of rain will obliterate the London purple, and the worms will finally return, when another application may be made. It is fast work, and can be put on almost as fast as a man can walk. A half pound of the insecticide will go over forty acres, and costs but a few cents.

In the experiments made this year it has been proved that the above application is not only harmless to the plants, but also harmless in the prepared cabbage, from the fact that if anything deleterious had been absorbed by the plant, it is shelled off in the outside leaves, or washed away by the rains. Our family are as fond of cabbage as the veriest Dutchman from the Rhine, and we have consumed it freely this season, and continue to do so. We have no fears whatever of any bad effects of London purple in such very small quantity upon a plant, and it certainly "gets away" with the worms. This discovery is of value to all, and the writer takes pleasure in making it public for the public good.—*Prairie Farmer.*

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TABLE OF CONTENTS.

PAGE

I. ENGINEERING AND MECHANICS.—Cold Air Machines..... 4011
The English 100-Ton Gun..... 4011
Safety hooks. By a Mining Engineer. 3 figures. Booth and Sugden's hooks..... 4011
Consolidation Locomotive for the Philadelphia and Reading Railroad. 2 large figures. Consolidation Locomotive with Wootten's fire box for burning fine coal.—Back end view of Consolidation Locomotive..... 4012
Fast Passenger Locomotive..... 4013
When the Timber is Gone, What?..... 4013
Apparatus for Measuring Strains in Structures. 1 figure. Apparatus for measuring strains..... 4014
How to Make a Telescope. By GEORGE M. HOPKINS. 7 figures. A method for making a cheap and efficient telescope for student's use. (Working drawings)..... 4014

II. CHEMISTRY AND TECHNOLOGY.—Apparatus for Continuous Distillation System. By VON EGROT. 1 illustration. Von Egrot's improved distilling apparatus..... 4007
The India-Rubber and Gutta Percha Industries. By THOMAS HOLLAS. (Continued from No. 250). Lecture V. Ebonite or Vulcanite.—Dental rubber.—Vulcanized oil.—Substitutes for rubber.—Celluloid. Lecture VI. Gutta percha..... 4008
Preparation of Opium for Smoking. By HUGH MCCALLUM, Hong Kong..... 4010
Freezing Mixtures. By A. DITTE..... 4010
Compression of Gaseous Mixtures. By L. CAILLETET..... 4010
A New Triamidotriphenylmethane (Pseudoleucaniline.) By O. FISCHER and J. ZIEGLER..... 4010
Ethereal Oil from the California Bay Tree. By J. M. STILLMAN. 4010
Abietic Acid. By W. KELBE..... 4010
Valuation of Bituminous Rocks and Limestones. By P. KIENLEN..... 4010

III. HYGIENE, MEDICINE, ETC.—Constant Bath Treatment of Fever..... 4017
The Cure of Constitutional Diseases by the Use of Glasses. A clinical lecture by Dr. D. B. ST. JOHN ROOSA..... 4018
Danger from Contagious Diseases Affecting the Lower Animals. By Prof. STALKER..... 4019
A Lesson on Curare and Other Poisons..... 4019
Effects of Inhaling Oxygen..... 4019
Dr Tanner's Lectures..... 4020
The Ultimate Structure of Living Organisms. By Dr. KARL SEILER..... 4020

IV. ELECTRICITY, ETC.—Atmospheric Electricity. By DAVID BROOKS..... 4016
A Florida Typhoon..... 4017

V. THE AMERICAN PHARMACEUTICAL ASSOCIATION, 28th ANNUAL MEETING.—Papers and Proceedings.—The mineral springs of Saratoga.—Fluid extracts.—Ferric hydrate.—Rhamnus purshiana.—Aspidum marginale.—Leptandra.—Fruit sirups..... 4019

VI. ASTRONOMY.—The Earth as Seen from Other Stars. 6 figures.—The earth as seen from Mercury.—The earth as seen from Venus.—The earth as seen from the moon.—The earth as seen from Mars.—The earth as seen from Jupiter.—The earth as seen from Saturn. 4021

VII. HORTICULTURE, ETC.—A New York Orchard..... 4022
Remedy for the Cabbage Worm..... 4022

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